FLECTION-TRANSMISSION TEST U

8743A

HP PART NUMBER 08743-90010

SERIALS PREFIXED: 1226-

HEWL
PACK

REFLECTION-TRANSMISSION TEST UNIT
8743A

HP PART NUMBER 08743-90010

SERIALS PREFIXED: 1226-

This manual applies directly to HP Model 8743A Reflection-Transmission Test Units having serial prefix number 1226-.

SERIAL PREFIXES NOT LISTED

For serial prefixes above 1226, a "Manual Changes" sheet is included with this manual. For serial prefixes below 1226, refer to the Appendix.

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1400 FOUNTAIN GROVE PARKWAY, SANTA ROSA, CALIFORNIA, 95404, U.S.A.

MANUAL PART NO. 08743-90010
MICROFICHE PART NO. 08743-90011

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HEWLETT hp PACKARD

TABLE OF CONTENTS

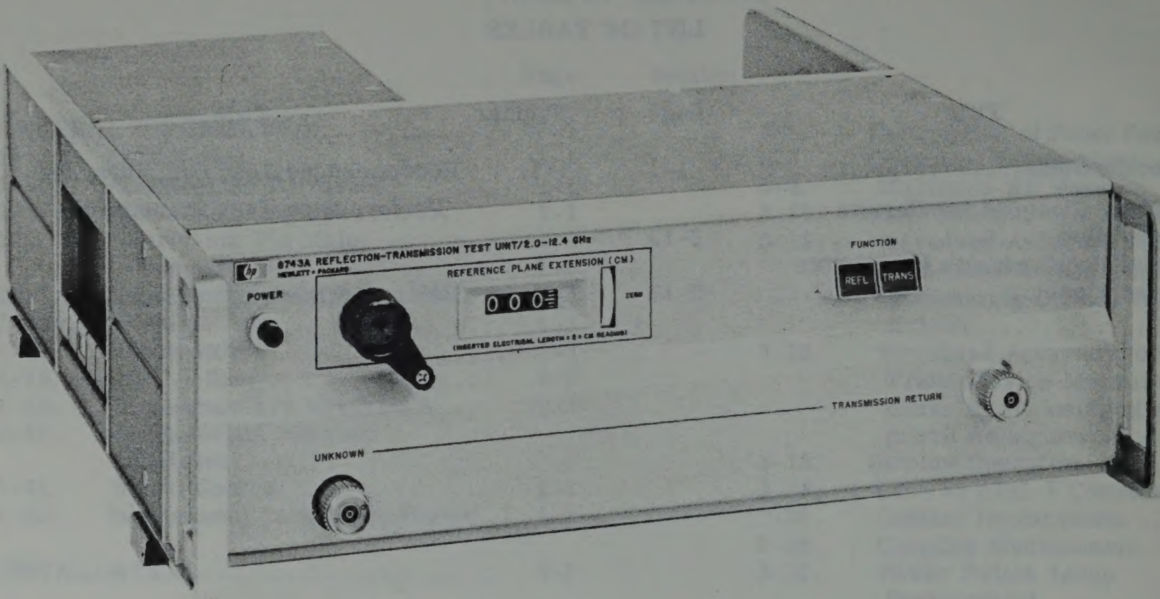
Section			Page
I	GENERAL INFORMATION		1-1
	1-1.	Description	1-1
	1-5.	Accessories Furnished	1-1
	1-7.	Rack-Mounting Kit	1-1
	1-9.	Thirty-six Pin Male Connector	1-1
	1-11.	Accessories Available	1-2
	1-12.	Flexible Arm	1-2
	1-14.	Attenuator	1-2
	1-16.	APC-7 Short	1-2
	1-18.	Complementary Equipment	1-2
	1-19.	Model 8410A Network Analyzer	1-2
	1-21.	Signal Source	1-2
	1-23.	Instruments Covered by Manual.	1-2
II	INSTALLATION		2-1
	2-1.	Incoming Inspection	2-1
	2-3.	Repackaging for Shipment	2-1
	2-4.	Using Original Packaging	2-1
	2-8.	Using Other Packaging	2-1
	2-10.	Preparation For Use	2-1
	2-11.	Power Requirements	2-1
	2-13.	115/230 Volt Operation	2-1
	2-16.	Power Cable	2-1
	2-19.	Bench Operation	2-1
	2-21.	Rack Mounting	2-1
III	OPERATION		3-1
	3-1.	Introduction	3-1
	3-6.	Description of Panel Features	3-1
	3-8.	Operating Precautions	3-1
	3-9.	Maximum RF Power	3-1
	3-11.	Measurement Procedures	3-1
	3-13.	Increased Accuracy for Reflection Measurements by Minimizing Directivity Errors	3-12
	3-16.	Increased Accuracy for Transmission Measurements by Reducing Mismatch Ambiguity	3-12
	3-18.	Remote Operation	3-13
	3-20.	Care of APC-7 Connectors	3-13
	3-23.	Contact Replacement	3-13
	3-28.	Coupling Mechanisms	3-16
	3-32.	Power Switch Lamp Replacement	3-16
IV	MAINTENANCE		4-1
	4-1.	Introduction	4-1
	4-3.	RF Troubleshooting	4-1
	4-5.	Performance Test Procedures	4-1
V	REPLACEABLE PARTS		5-1
	5-1.	Introduction	5-1
	5-3.	Ordering Information	5-1
VI	SCHEMATIC DIAGRAMS		6-1
	6-1.	Introduction	6-1

LIST OF ILLUSTRATIONS

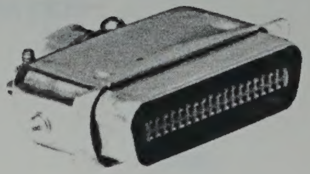
Number	Title	Page
1-1.	Model 8743A Reflection-Transmission Test Unit	1-0
3-1.	Front Panel Features	3-2
3-2.	Rear Panel Features	3-3
3-3.	Reflection Measurement, Using Network Analyzer with 8413A Display	3-4
3-4.	Transmission Measurement, Using Network Analyzer with 8413A Display Unit	3-6
3-5.	Reflection Measurement, Using Network Analyzer with 8414A Polar Display Unit	3-8
3-6.	Transmission Measurement, Using Network Analyzer with 8414A Polar Display Unit	3-10
3-7.	Measured Reflection Coefficient	3-12
3-8.	Locus of Measured Reflection with Load is Moved	3-12
3-9.	Locus of Measured Reflection with Directivity Cancelled	3-12
3-10.	Typical Transistor Remote Control Circuit	3-13
3-11.	APC-7 Connectors	3-14
3-12.	Pushbutton Selector Bulb Replacement	3-15
4-1.	Performance Test	4-2
4-2.	Insertion Loss Troubleshooting	4-7
4-3.	Position of Outer Conductor Washer	4-8
6-1.	General Information on Schematic Diagrams	6-1
6-2.	Schematic Diagram Notes	6-2
6-3.	8743A Component Identification, Top View	6-3
6-4.	8743A Component Identification, Bottom View	6-3
6-5.	Simplified RF Schematic Diagram	6-4
6-6.	RF Schematic Diagram	6-5
6-7.	Relay Driver Input Circuit Talking Schematic Diagram	6-6
6-8.	Relay Driver Assy Component Diagram	6-7
6-9.	Relay Driver Assy Component Identification	6-8
6-10.	Switch Assy Component Identification	6-8
6-11.	Relay Driver Assy Schematic Diagram	6-9
6-12.	Power Supply Assy Component Identification	6-10
6-13.	Power Supply Schematic Diagram	6-11
A-1.	Pushbutton Lamp Replacement	A-2

LIST OF TABLES

Number	Title	Page
1-1.	Specifications....................	1-1
3-1.	Contact Closures for Remote Operation...................... ..	3-13
3-2.	Signal Requirements for Remote Operation..........................	3-13
4-1.	Recommended Test Equipment for Performance Test Procedure......	4-1
5-1.	Reference Designation Index........	5-2

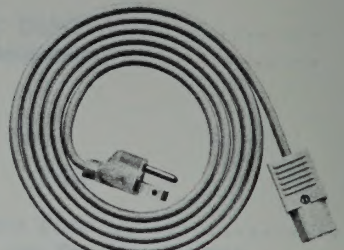

8743A REFLECTION-TRANSMISSION TEST UNIT/2.0-12.4 GHz
HEWLETT • PACKARD
POWER
REFERENCE PLANE EXTENSION (CM)
0 0 0
ZERO
(INSERTED ELECTRICAL LENGTH = 2 × CM READING)
FUNCTION
REFL
TRANS
TRANSMISSION RETURN
UNKNOWN

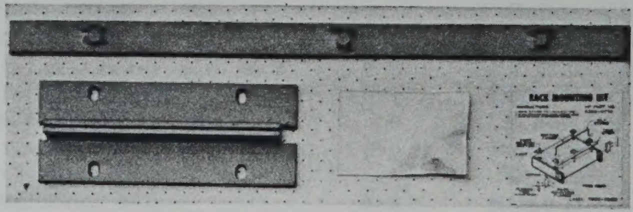
8743A



36 PIN
CONNECTOR

POWER CABLE





RACK MOUNTING KIT

Figure 1-1. MODEL 8743A REFLECTION-TRANSMISSION TEST UNIT.

SECTION I

GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The Model 8743A Reflection - Transmission Test Unit is a complementary instrument for the HP 8410A Network Analyzer. It contains microwave circuits for making reflection and transmission measurements from 2.0 to 12.4 GHz. The RF circuit for a transmission or a reflection measurement is set up by a front panel pushbutton or with remote contact closures.

1-3. A calibrated internal line stretcher with a high resolution digital indicator compensates for the electrical length of the device under test - up to 15 cm for reflection tests, and up to 30 cm for transmission tests. If more compensation is needed, additional line may be installed in place of the removable rigid coax link on the rear panel.

1-4. As shown in Figure 6-5 both the reference and test channels are isolated from the signal source by 20 dB. In addition to padding source mismatch, the attenuation in the test channel permits measurements on small-signal devices.

1-5. ACCESSORIES FURNISHED.

1-6. A rack-mounting kit, a male 36-pin connector (HP part number 1251-0084) and a detachable power cable are furnished with the Model 8743A.

1-7. RACK-MOUNTING KIT.

1-8. The rack-mounting kit contains all the hardware needed to adapt the Model 8743A cabinet for installation in equipment racks with standard 19-inch spacing. Instructions for conversion to rack mounting are included with the kit.

1-9. THIRTY-SIX PIN MALE CONNECTOR.

1-10. The 36-pin male connector mates with the rear-panel REMOTE INPUT connector, and permits all necessary remote programming connections to be made to the 8743A. (See Table 3-1 for wiring information.)

Table 1-1. Specifications.

Frequency Range: 2.0 to 12.4 GHz.

Impedance: 50 ohms nominal.

Reflection Coefficient
UNKNOWN port:* 2-8 GHz, ≤ 0.091 (VSWR 1.2)
8-12.4 GHz, ≤ 0.13 (VSWR 1.3)
TRANSMISSION RETURN port:
REFL Measurement: ≤ 0.13 (VSWR 1.3)
TRANS Measurement: ≤ 0.20 (VSWR 1.5)

Coupler Directivity: 30 dB

Insertion Loss:

RF Input to REFERENCE output: 30 dB nominal

RF Input to UNKNOWN port: 20 dB nominal

UNKNOWN port to TEST output in Reflection mode: 10 dB nominal

TRANSMISSION RETURN port to TEST output in transmission mode: <1.5 dB.

Maximum RF input: 8743A damage level, 2 W

Connectors:

RF INPUT port: Type N[1] female, stainless steel.

REFERENCE and TEST channel output ports mate with APC-7[2] connectors.

TRANSMISSION and UNKNOWN ports: APC-7[2] sexless connectors

REMOTE INPUT: 36 pin female.

Microwave Switches: Typical switching time, 40 msec. Estimated switch lifetime 1 million cycles.

Reference Plane Extension: 0 to 15 cm for reflection; 0 to 30 cm for transmission; calibrated by dial indicator. Indicator is adjustable for initial calibration.

Transmission-Reflection Selection: Manual by front-panel, lighted pushbuttons. Remote by contact closures or saturated transistors through 36-pin connector at rear panel. Pin 17 to pins 18 or 36 (ground) selects remote operation. Opening or closing pin 24 to pins 18 or 36 selects Reflection or Transmission. Pins 17 and 24 are at 12V and short to ground will draw 12 mA.

Accessories Furnished:

Rack-mounting kit
36-pin male connector
Power cable

---

[1] Compatible with connectors whose dimensions conform to MIL-C-39012 or MIL-C-71.

[2] Amphenol RF Division, Danbury, Connecticut.

*Equivalent source reflection coefficient when used with 8410A Network Analyzer.

1-11. ACCESSORIES AVAILABLE.

1-12. FLEXIBLE ARM.

1-13. The Model 11605A Flexible Arm is a combination of three rotary air lines and three swivel joints. It combines the phase stability of rigid line with the flexibility of cable so that devices with any port geometry can be connected to the 8743A.

1-14. ATTENUATOR.

1-15. A 50-ohm coaxial attenuator is recommended for transmission measurements. An attenuator connected between the output of the device under test and the HP 11605A Flexible Arm reduces the ambiquity due to mismatch between the 11605A, 8743A,and 8411A. A 10-dB low reflection attenuator, such as a HP 8492A Option 10, reduces this ambiguity to essentially that of the attenuator (VSWR ≤ 1.25). In addition to reducing error due to mismatch, the 10-dB attenuator makes the test channel power level during calibration the same for transmission and reflection. Also, the combined electrical lengths of the 8492A and 11605A make the electrical length of the test channel in the transmission mode nearly equal to its length in the reflection mode. This means, that since the difference is small, it is possible to calibrate for one mode of operation and switch to the other without recalibrating.

1-16. APC-7 SHORT.

1-17. The Model 11565A APC-7 Short is useful for establishing reflection measurement, phase and magnitude, reference.

1-18. COMPLEMENTARY EQUIPMENT.

1-19. MODEL 8410A NETWORK ANALYZER.

1-20. The 8410A Network Analyzer measures relative amplitude and phase of two RF input signals. The instrument is capable of single or swept frequency measurements,in the range of 0.11 to 12.4 GHz. Two plug-in display units are available. The 8413A plug-in unit displays relative amplitude and phase data on a meter. Phase and amplitude output signals allow display of swept signals on an oscilloscope or X-Y recorder. The 8414A plug-in unit displays relative amplitude and phase data in polar coordinates on a 5-inch CRT for either swept or CW mode of measurement.

1-21. SIGNAL SOURCE.

1-22. HP 8690 Sweep Oscillator main frames with 8692B, 8693B and 8694B RF plug-in units provide swept frequency coverage of the entire 8743A frequency range. These oscillators have features which make them especially compatible with the 8410A Network Analyzer system. For example, the sweep reference voltage output permits the 8410A phase lock system to track the fastest sweeps for flicker-free oscilloscope displays. Also, the between-sweep pause at the start frequency enables the Network Analyzer to phase lock solidly before a sweep begins.

1-23. INSTRUMENTS COVERED BY MANUAL.

1-24. Each Model 8743A carries a two-section, eight-digit serial number (000-00000). The first three digits of the number are a prefix. The contents of this manual apply directly to the Model 8743A which has the same serial number prefix(es) as those listed after SERIALS PREFIXED on the title page.

1-25. Revisions required to adapt this manual to other serial number prefixes are given in a yellow-sheet Manual Changes insert, supplied with the manual. For information concerning serial number prefixes not listed on the title page or in an insert, contact the nearest Hewlett-Packard office listed at the rear of this manual.

SECTION II

INSTALLATION

2-1. INCOMING INSPECTION.

2-2. Inspect the instrument for shipping damage as soon as it is unpacked. Check that all accessories listed in Paragraph 1-7 have been included. Check for broken knobs and connectors; inspect cabinet and panel surfaces for dents and scratches. If the instrument is damaged in any way, or fails to operate properly, notify carrier and your nearest Hewlett-Packard Sales and Service Office. For assistance of any kind, including instruments under warranty, contact the nearest Hewlett-Packard Sales Office listed at the back of this manual.

2-3. REPACKAGING FOR SHIPMENT.

2-4. USING ORIGINAL PACKAGING.

2-5. The same containers and materials used in factory packaging can be obtained through the Hewlett-Packard offices listed at the rear of this manual. Remove the rear-panel coaxial link, wrap it separately and include in shipping container.

2-6. If the Model 8743A is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling.

2-7. In any correspondence, refer to the instrument by model number and full serial number.

2-8. USING OTHER PACKAGING.

2-9. The following general instructions should be used when repackaging with commercially-available materials:

a. Wrap the 8743A and the rear-panel coaxial link separately in heavy paper or plastic. (If shipping to a Hewlett - Packard service office or center, attach a tag indicating the type of service required, the return address, model number, and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 350 pound test material is adequate.

c. Use enough shock-absorbing material (3 to 4 inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely, and mark it FRAGILE to assure careful handling.

e. In any correspondence refer to the instrument by model number and full serial number.

2-10. PREPARATION FOR USE.

2-11. POWER REQUIREMENTS.

2-12. The Model 8743A requires a power source of 115 or 230 volts ±10%, 50 to 1000 Hz, single phase that can supply approximately 20 watts.

2-13. 115/230 VOLT OPERATION.

2-14. A two-position slide switch on the rear panel of the Model 8743A permits operation from either a 115- or 230-volt power source. The number showing on the switch slider indicates the voltage for which the instrument is connected. The correct line fuse rating for each line voltage is marked on the plate adjacent to the fuse.

2-15. To prepare the Model 8743A for operation, position the 115-230 volt switch so that the number showing on the slider corresponds to the available line voltage, and install a line fuse of correct rating. "Slo-blo" fuses should be used.

CAUTION

> To avoid damage to the instrument, set the 115-230 switch to the line voltage to be used before connecting the power cable.

2-16. POWER CABLE.

2-17. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that instrument panels and cabinets be grounded. Accordingly, the Model 8743A is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds panel and cabinet. The offset pin of the three-prong connector is the grounding pin.

2-18. To preserve the protection feature when operating the Model 8743A from a two-contact outlet, use a three-prong to two-prong adapter (HP part number 1251-0048), and connect the green wire on the adapter to ground.

2-19. BENCH OPERATION.

2-20. The Model 8743A cabinet has plastic feet and a foldaway tilt stand for convenience in bench operation. The stand inclines the instrument enough to make the panel features easier to see. The plastic feet provide clearance for air circulation and make the Model 8743A self - aligning when stacked on other Hewlett-Packard full rack-width modular instruments.

2-21. RACK MOUNTING.

2-22. All necessary hardware and instructions are contained in the supplied rack - mounting kit (HP part number 5060-0775). Care must be taken to insure that the ambient operating temperature does not exceed 55° C (140° F).

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. The combination of the Model 8743A Reflection-Transmission Test Unit with the Model 11605A Flexible Arm, a signal source, and a compatible phase-amplitude ratio indicator, such as the HP Model 8410A Network Analyzer, makes up a system for measuring reflection and transmission, phase and magnitude, from 2.0 to 12.4 GHz.

3-3. The microwave circuit for a reflection or transmission measurement is set up by pressing a front panel pushbutton or with remote contact closures.

3-4. A calibrated line stretcher with a digital indicator is used to equalize the electrical length of the test and reference channels for initial phase calibration. A thumbwheel allows the digital indicator to be set to zero or to any desired reference. For reflection measurements, in cases where the measurement plane is not to be at the UNKNOWN port, the line stretcher can be adjusted to extend the measurement plane up to 15 cm beyond the UNKNOWN port. For transmission measurements, the line stretcher can be used to determine the total electrical length (up to 30 cm) of the device under test. For either function, additional line may be installed in place of the removable rigid coax link (REFERENCE LINE) on the rear panel.

3-5. A special recess for the HP 8410A Network Analyzer's harmonic frequency converter permits direct connection to the 8743A with no increase in package dimensions.

3-6. DESCRIPTION OF PANEL FEATURES.

3-7. Front and rear panel controls, connectors, and indicators are described in Figures 3-1 and 3-2. In these figures the numbers on the panel illustrations match the description numbers.

3-8. OPERATING PRECAUTIONS.

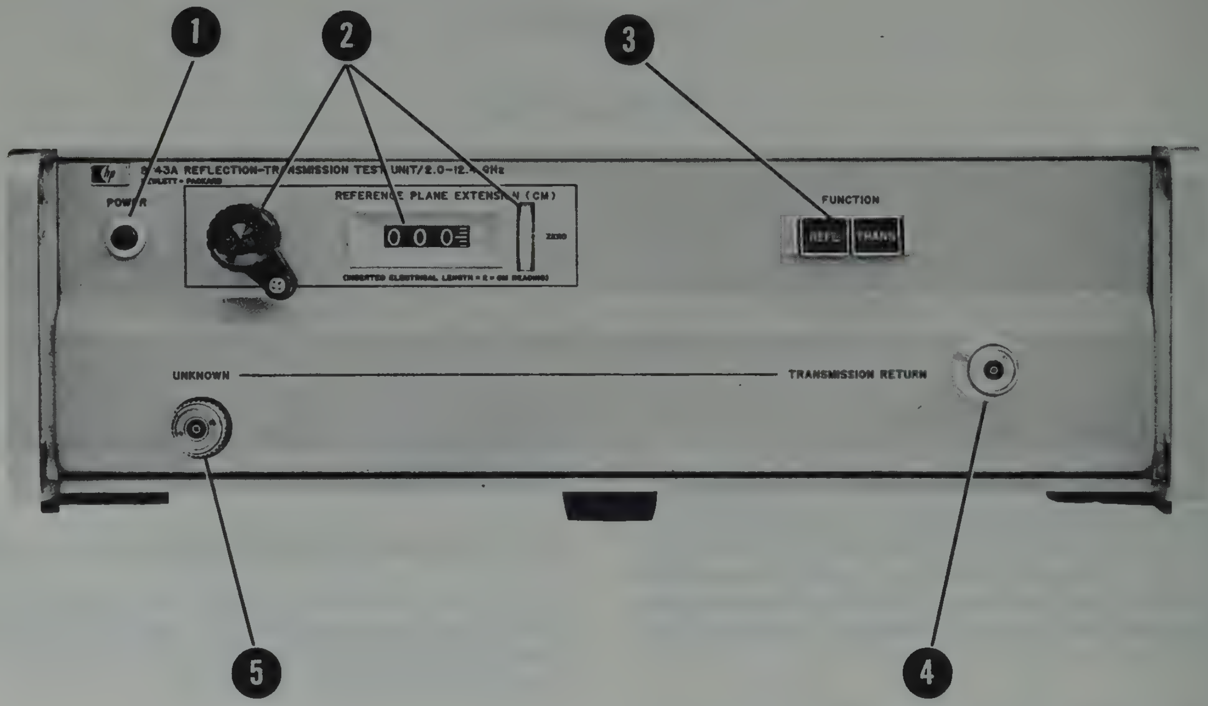
3-9. MAXIMUM RF POWER.

3-10. Do not apply more than 2 watts of RF power to the rear-panel RF INPUT. Power in excess of 2 watts may damage the internal directional couplers. When making transmission measurements using the 8410A Network Analyzer, do not apply more than 50 mW to the 8743A TRANSMISSION RETURN port. More than 50 mW may damage the 8411A Harmonic Frequency Converter.

3-11. MEASUREMENT PROCEDURES.

3-12. Procedures for making transmission and reflection measurements using the HP 8743A with the HP 8410A Network Analyzer are included in Figures 3-3 through 3-6.

FRONT PANEL FEATURES


1
2
3
8743A REFLECTION-TRANSMISSION TEST UNIT/2.0-12.4 GHz
HEWLETT • PACKARD
POWER
REFERENCE PLANE EXTENSION (CM)
000
ZERO
(INSERTED ELECTRICAL LENGTH = 2 × CM READING)
FUNCTION
REFL
TRANS
UNKNOWN
TRANSMISSION RETURN
5
4

1. POWER. Combination line power switch and power on indicator. Pushbutton glows when instrument is on. Pushbutton retainer unscrews for lamp replacement.

2. REFERENCE PLANE EXTENSION (CM). Crank controls internal line stretcher to equalize the electrical length of the test and reference channels for initial calibration and to compensate for the electrical length of the device under test-up to 15 cm for reflection tests, and up to 30 cm for transmission tests. ZERO thumbwheel is for setting reference indication on counter without changing line length. If more compensation is needed, additional line may be installed in place of the removable rigid coax link on the rear panel.

3. FUNCTION selectors. Set up the internal microwave circuits for making reflection or transmission measurements. Pushbutton glows, indicating function selected.

4. TRANSMISSION RETURN port. Makes RF connection from the device under test for transmission measurements. APC-7 type* 50-ohm precision 7mm sexless connector.

5. UNKNOWN port. Makes RF connections to the device under test for reflection or transmission measurements. APC-7 type* 50-ohm precision 7mm sexless connector.

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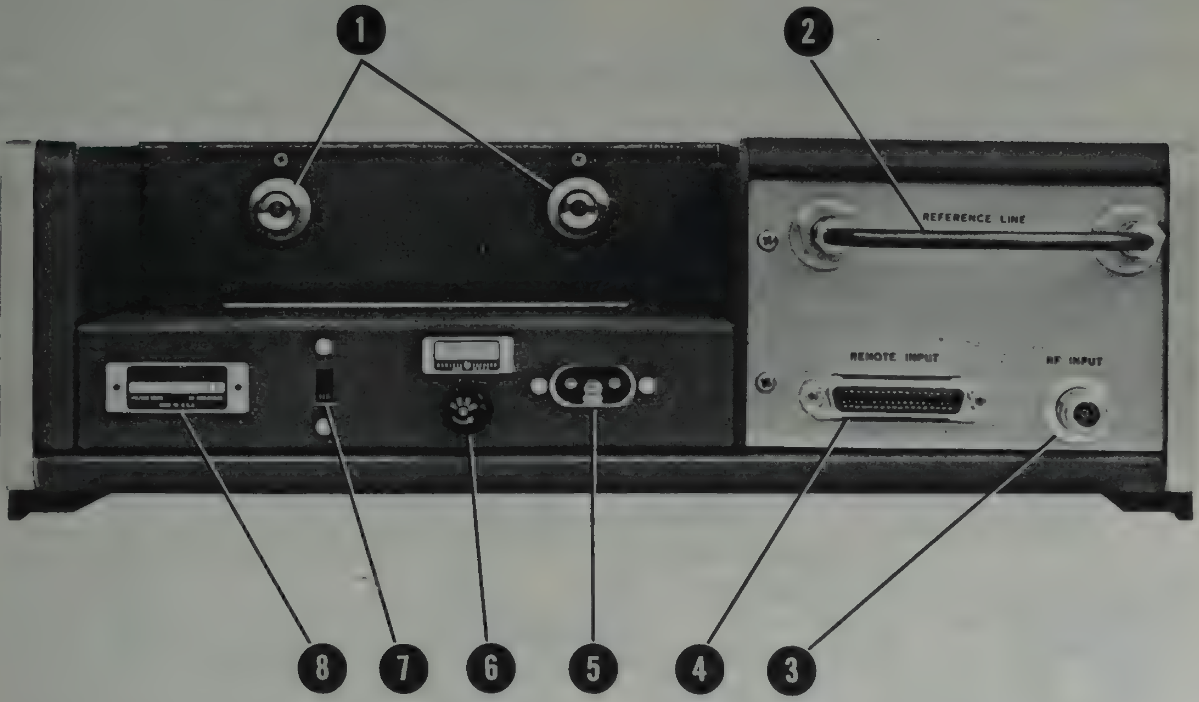
* Amphenol RF Division, Danbury, Connecticut. See Figure 3-11 for important information about use, care of APC-7 connectors.

Figure 3-1. Front Panel Features

REAR PANEL FEATURES

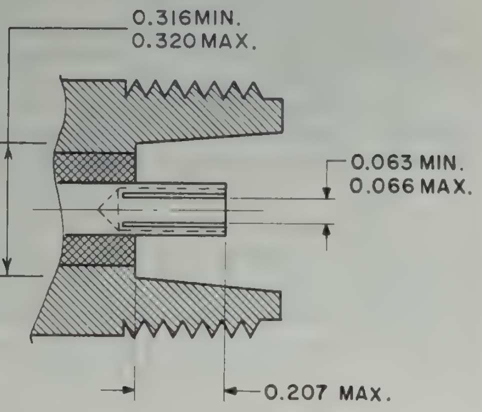


1. REFERENCE and TEST output ports. Reference and Test channel outputs to phase-amplitude indicator. Mate with APC-7* style 50-ohm precision 7mm connectors. The REFERENCE channel connector is mechanically floating to assure alignment with 8411A Harmonic Frequency Converter of HP 8410A Network Analyzer.

2. REFERENCE LINE. May be replaced with a longer section of rigid coax cable to extend the range of the REFERENCE PLANE EXTENSION to any desired length.

3. RF INPUT. Input for RF signal that is applied to the device under test. Frequency range is 2.0 to 12.4 GHz. Maximum RF power level is 2 watts. Connector is 50-ohm type N and mates compatibly with type N connectors whose dimensions conform to MIL-C-39012 and MIL-C-7 (see dimension drawing).

4. REMOTE INPUT. Accepts contact closure type remote programming to select the function to be measured. Nominal voltage from the 8743A when the contact is open is 12 Vdc. Maximum current from the 8743A when the contact is short circuited is 12 mA.



5. Power Cable Connector. NEMA type with offset pin connected to 8743A cabinet. Power requirements: 115 or 230 V ac ±10%, 50 to 1000 Hz, approximately 20 watts.

6. Power Line Fuse Holder. "Slo-blo" fuse rating for 115 and 230 Vac on adjacent plate.

7. Line Voltage Selector. Permits operation from 115 or 230 Vac. Number showing on slider is the selected operating voltage. Correct line fuse rating is on plate adjacent to fuse holder.

8. Serial Number Plate. Eight-digit serial number should be included in any correspondence concerning the 8743A

Figure 3-2. Rear Panel Features

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* Amphenol RF Division, Danbury, Connecticut.

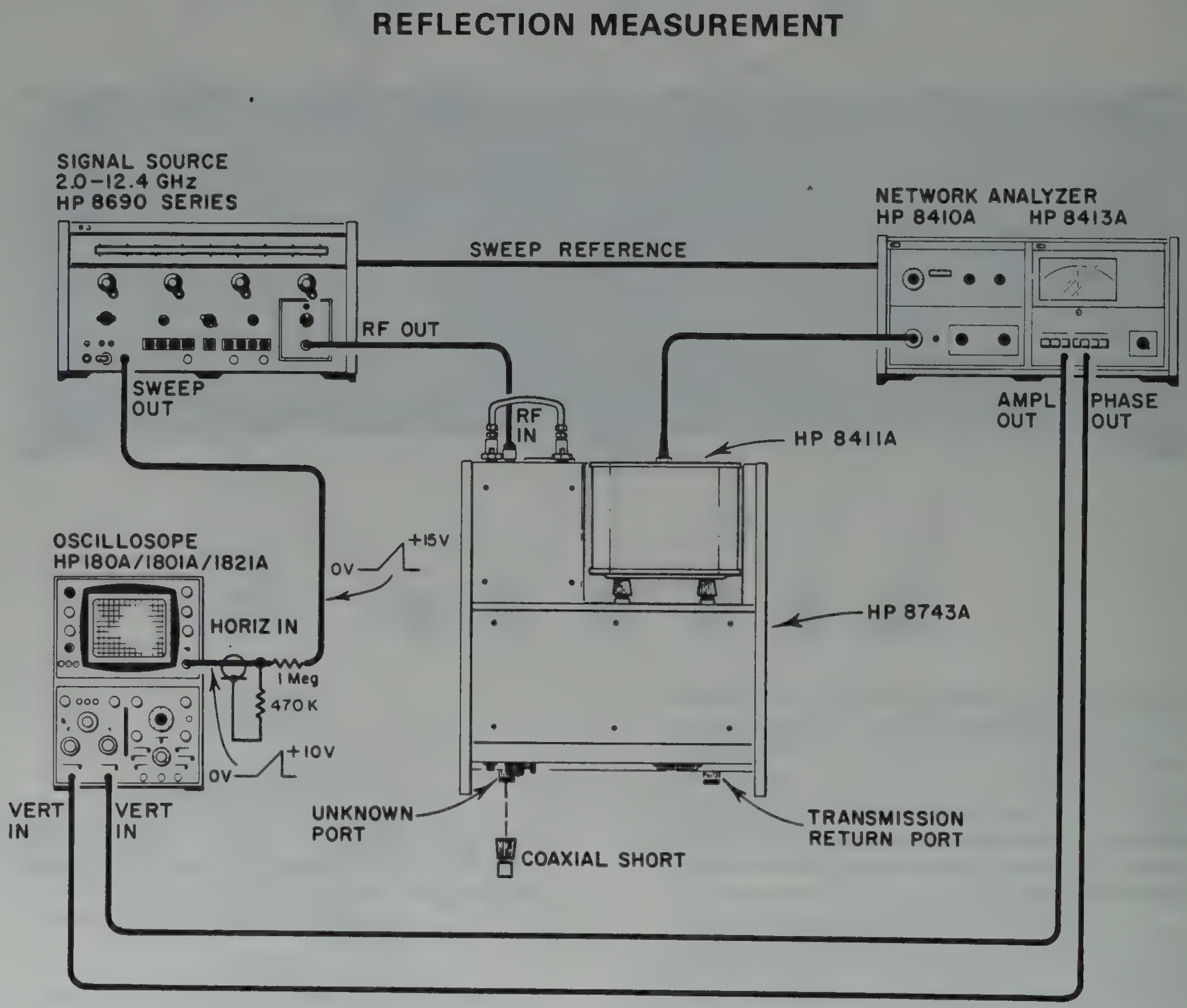


Figure 3-3. Reflection Measurement, Using Network Analyzer with 8413A Display Unit. (Sheet 1 of 2)

CALIBRATION

DESCRIPTION. Calibration consists of adjusting the 8743A REFERENCE PLANE EXTENSION to obtain equal reference and test channel electrical lengths and obtaining reference, magnitude and phase, indications using a termination of known magnitude and phase angle.

PROCEDURE.

1. Connect equipment as shown in setup.
2. Connect a coaxial short such as the HP 11565A to the 8743A UNKNOWN port and depress the REFL pushbutton.
3. Adjust 8413A phase offset control for 180° offset (either polarity).
4. Set the Sweep Oscillator to automatic sweep. Adjust the Sweep Oscillator and Network Analyzer controls to phase lock the Network Analyzer over the frequency band of interest.
5. Adjust the oscilloscope to display the swept phase output from the 8413A.
6. Obtain equal reference and test channel electrical lengths by adjusting the REFERENCE PLANE EXTENSION for a horizontal phase display on the oscilloscope. If the plane of measurement is to be extended beyond the plane of the short, the digital counter should be set to zero so that it can be used to set the required extension accurately. A convenient way to do this is as follows:
   - a. Adjust REFERENCE PLANE EXTENSION crank until counter reads all zeros.
   - b. Hold thumbwheel to retain zero indication and readjust REFERENCE PLANE EXTENSION for a horizontal display on the oscilloscope.
7. For swept-frequency measurements, adjust the oscilloscope display as follows:
   - a. Disconnect oscilloscope vertical input from 8413A AMPLITUDE channel, to simulate zero volts dc from 8413A. Note trace position.
   - b. Reconnect vertical input and adjust 8410A test channel gain and amplitude vernier controls so that the average of the trace falls on the zero trace position noted in step (a) above.
   - c. Adjust oscilloscope vertical position for a convenient amplitude reference.
   - d. Disconnect oscilloscope vertical input from 8413A PHASE channel, to simulate zero volts dc from 8413A. Note trace position.
   - e. Reconnect vertical input and adjust 8410A phase vernier control so that the average of the trace falls on the zero trace position noted in step (d) above.
   - f. Adjust oscilloscope vertical position for a convenient phase reference.
8. To calibrate for single-frequency measurements, perform the following:
   - a. Set the Sweep Oscillator for single-frequency operation.
   - b. Adjust the 8410A PHASE VERNIER for a zero degree indication on the 8413A.
   - c. Adjust 8410A test channel gain and amplitude vernier controls for a 0 dB indication on the 8413A.

NOTE

Calibration for greater accuracy is discussed in Paragraph 3-14 and 3-15.

MEASUREMENT.

1. Remove the coaxial short and connect the device to be tested to the 8743A UNKNOWN port.
2. Return the 8413A phase offset to zero.
3. For swept-frequency measurements, read magnitude and phase as follows:
   - a. For magnitude, note 8410A test channel gain settings. Increase test channel gain to return oscilloscope display to reference obtained during calibration. The difference in test channel gain settings is the reflection magnitude in return loss[1].
   - b. For phase, adjust oscilloscope vertical sensitivity and position controls to view the swept-phase display of the device under test. Use the calibrated 8413A output (10 mV/degree) and the oscilloscope vertical calibration to determine phase angle.
4. For single-frequency measurements, read magnitude and phase as follows:
   - a. For magnitude, note 8410A test channel gain settings. Increase test channel gain to return the 8413A meter indication to zero. The difference in test channel gain settings is the reflection magnitude in return loss.[1]
   - b. For phase, adjust the 8413A phase offset for an on scale meter indication on the most sensitive scale. The phase angle is the algebraic sum of phase offset and meter indication.

---

[1] $|\rho| = \dfrac{1}{\text{Log}^{-1}(0.05 \times \text{Return Loss})}$

Figure 3-3. Reflection Measurement, Using Network Analyzer with 8413A Display Unit. (Sheet 2 of 2)

TRANSMISSION MEASUREMENT

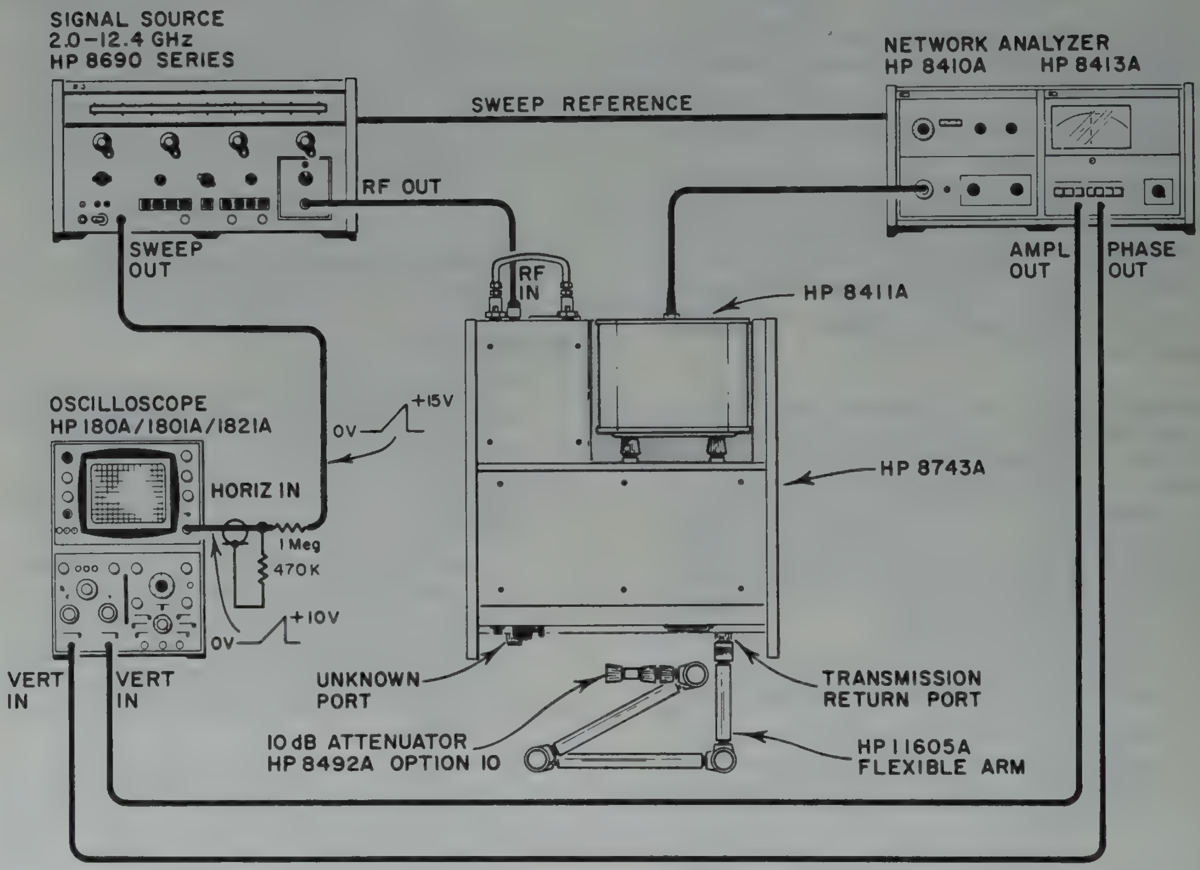


Figure 3-4. Transmission Measurement, Using Network Analyzer with 8413A Display Unit (Sheet 1 of 2)

CALIBRATION

DESCRIPTION. Calibration consists of adjusting the 8743A REFERENCE PLANE EXTENSION to obtain equal reference and test channel electrical lengths and obtaining reference, magnitude and phase, indications.

PROCEDURE.

1. Connect equipment as shown in setup. Connect a 10-dB attenuator, such as the HP 8492A Option 10, to the HP 11605A Flexible Arm (see Paragraph 3-17), and connect the attenuator to the 8743A UNKNOWN port.
2. Dc couple and dc balance the oscilloscope vertical amplifiers. Adjust the oscilloscope to display the swept-phase output from the 8413A.
3. Obtain equal reference and test channel electrical lengths by adjusting the REFERENCE PLANE EXTENSION for a horizontal phase display on the oscilloscope. If the digital counter is to be used to determine the electrical length of the device under test, it should be set to zero. A convenient way to do this is as follows.
    a. Adjust REFERENCE PLANE EXTENSION crank until counter reads all zeros.
    b. Hold thumbwheel to retain zero indication and readjust REFERENCE PLANE EXTENSION for a horizontal display on the oscilloscope.
4. For swept-frequency measurements, adjust the oscilloscope display as follows:
    a. Disconnect oscilloscope vertical input from 8413A AMPLITUDE channel to simulate zero volts dc from 8413A. Note trace position.
    b. Reconnect vertical input and adjust 8410A test channel gain and amplitude vernier controls so that the average of the trace falls on the zero trace position noted in step (a) above.
    c. Adjust oscilloscope vertical position for convenient amplitude reference.
    d. Disconnect oscilloscope vertical input from 8413A PHASE channel to simulate zero volts dc from 8413A. Note trace position.
    e. Reconnect vertical input and adjust the 8410A PHASE vernier control so that the average of the trace falls on the zero trace position noted in step (d) above.
    f. Adjust oscilloscope vertical position for a convenient phase reference.
5. To calibrate for single-frequency measurements perform the following:
    a. Set the Sweep Oscillator for single-frequency operation.
    b. Adjust 8410A PHASE VERNIER for zero degree indication on the 8413A.
    c. Adjust 8410A test channel gain and amplitude vernier controls for a 0 dB indication on the 8413A.

MEASUREMENT

1. Insert the device to be tested between the UNKNOWN port and the 10-dB attenuator.
2. For swept-frequency measurements, read magnitude and phase as follows:
    a. For magnitude, note 8410A test channel gain settings. Adjust test channel gain to return oscilloscope display to reference obtained during calibration. The difference in test channel gain settings is the transmission gain or loss in dB of the device under test.
    b. For phase, adjust oscilloscope vertical sensitivity and position controls to view the swept-phase display of the device under test. Use the calibrated 8413A output (10 mv/degree) and the oscilloscope vertical calibration to determine phase angle.

NOTE

The phase display is the combination of linear phase (due to electrical length) and non-linear phase shift. Group delay can be determined from this display (see HP Application Note 92).

3. For single-frequency measurements, read magnitude and phase as follows:
    a. For magnitude, note 8410A test channel gain settings. Adjust test channel gain to return the 8413A meter indication to zero. The difference in test channel gain settings is the transmission gain or loss in dB of the device under test.
    b. For phase, adjust the 8413A phase offset for an on-scale meter indication on the most sensitive scale. The phase angle is the algebraic sum of phase offset and meter indication.

Figure 3-4. Transmission Measurement, Using Network Analyzer with 8413A Display Unit (Sheet 2 of 2)

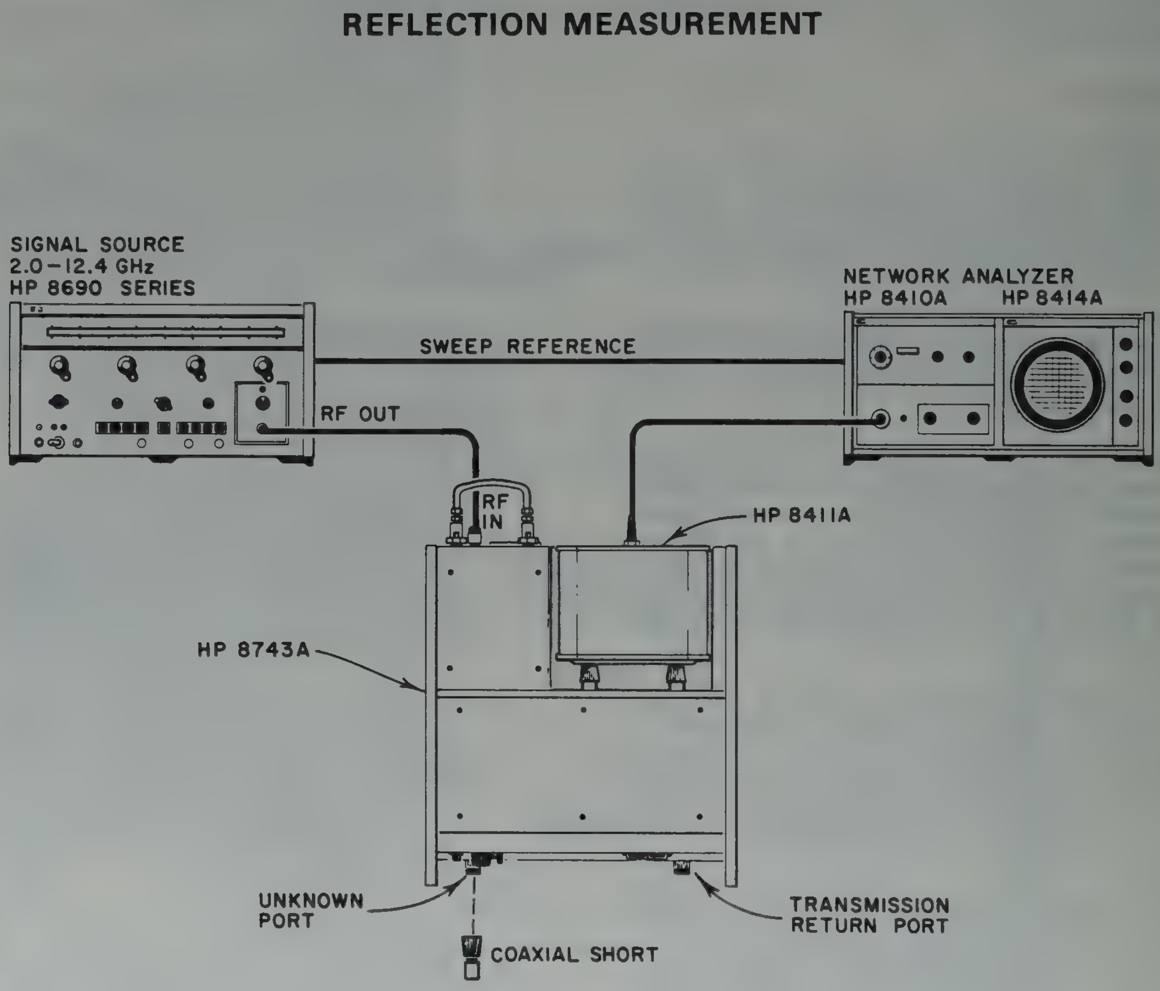


Figure 3-5. Reflection Measurement, Using Network Analyzer with 8414A Polar Display Unit (Sheet 1 of 2)

CALIBRATION

DESCRIPTION. Calibration consists of adjusting the 8743A REFERENCE PLANE EXTENSION to obtain equal reference and test channel electrical lengths and obtaining reference, magnitude and phase, indications.

PROCEDURE.

1. Connect equipment as shown in setup.
2. Connect a coaxial short such as the HP 11565A to the 8743A UNKNOWN port and depress the REFL pushbutton.
3. Set the Sweep Oscillator to automatic sweep. Adjust the Sweep Oscillator and Network Analyzer controls to phase lock the Network Analyzer over the frequency band of interest.
4. Push and hold the 8414A BEAM CTR pushbutton and adjust the centering controls to place the dot in the center of the polar display.
5. Obtain equal reference and test channel electrical lengths by adjusting the REFERENCE PLANE EXTENSION to collapse the trace to a dot or smallest cluster. If the plane of measurement is to be extended beyond the plane of the short, the digital counter should be set to zero so that it can be used to set the required extension accurately. A convenient way to do this is as follows:
    a. Adjust REFERENCE PLANE EXTENSION crank until counter reads all zeros.
    b. Hold thumbwheel to retain zero indication and readjust REFERENCE PLANE EXTENSION to collapse the trace to a dot or smallest cluster.
6. Adjust the 8410A PHASE VERNIER, TEST CHANNEL GAIN and AMPL VERNIER controls to place the dot or cluster for a reference indication of $\Gamma=1\underline{/180^\circ}$.

NOTE

Calibration for greater accuracy is discussed in Paragraph 3-14 and 3-15.

MEASUREMENT

1. Remove the coaxial short and connect the device to be tested to the 8743A UNKNOWN port.
2. Read the reflection coefficient, magnitude and phase, (or impedance using a Smith Chart overlay) from the 8414A display.

NOTE

For small reflection coefficients the 8414A resolution can be improved by increasing the 8410A test channel gain. For example, increasing the test channel gain by 20 dB changes the full scale reflection-coefficient calibration from 1.0 to 0.1 at the outer circle.

3. The effective load plane of the device under test may be determined by adjusting the REFERENCE PLANE EXTENSION to again collapse the trace to a dot or smallest cluster. The distance from reference plane to load plane may be read directly from 8743A digital counter (counter set to zero during calibration).

Figure 3-5. Reflection Measurement, Using Network Analyzer with 8414A Polar Display Unit (Sheet 2 of 2)

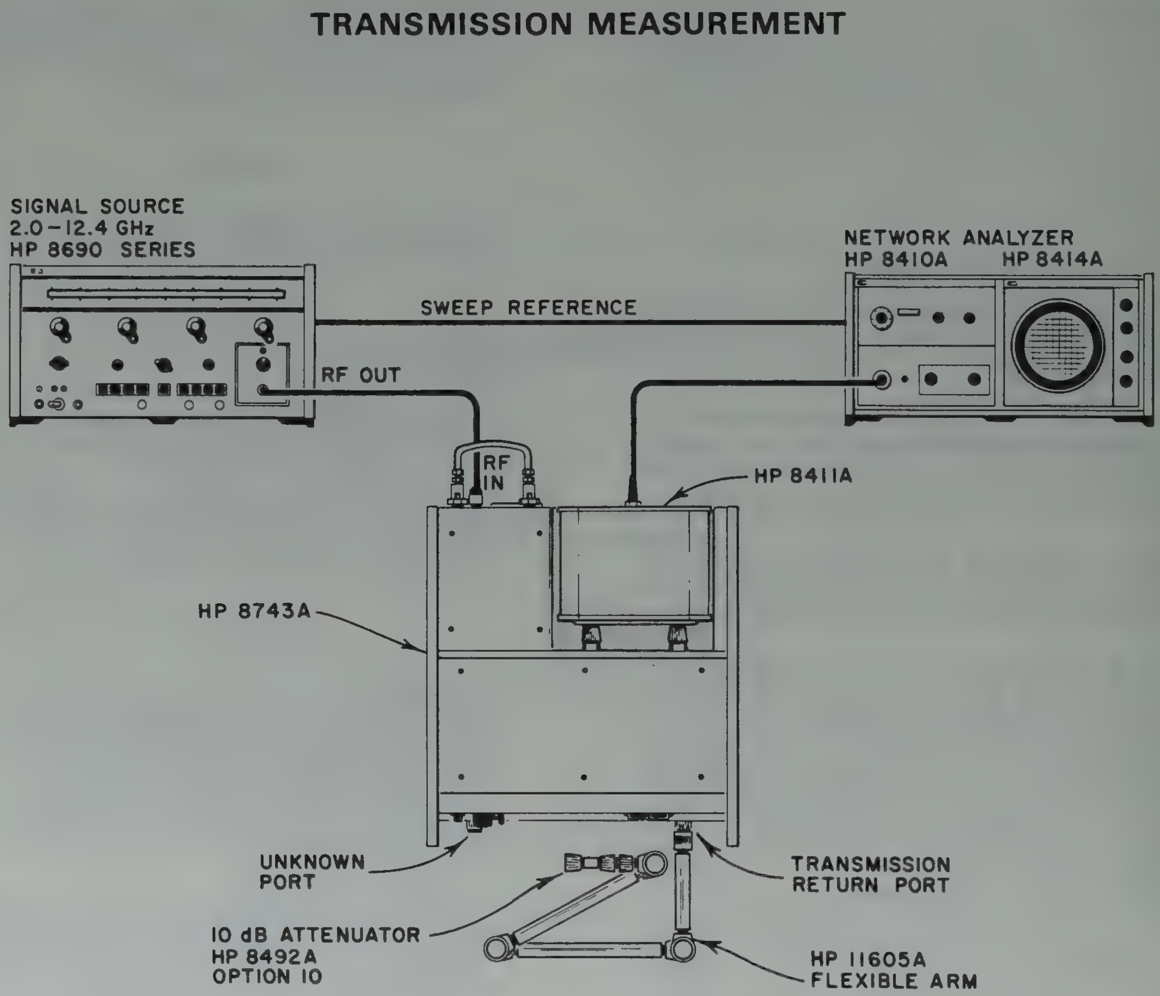


Figure 3-6. Transmission Measurements, Using Network Analyzer with 8414A Polar Display Unit (Sheet 1 of 2)

CALIBRATION

DESCRIPTION. Calibration consists of adjusting the 8743A REFERENCE PLANE EXTENSION to obtain equal reference and test channel electrical lengths and obtaining reference, magnitude and phase, indications.

PROCEDURE.

1. Connect equipment as shown in setup. Connect a 10-dB attenuator, such as the HP 8492A Option 10, to the Flexible Arm (see Paragraph 3-17) and connect the attenuator to the 8743A UNKNOWN port.
2. Depress the 8743A TRANS pushbutton.
3. Set the Sweep Oscillator to automatic-sweep. Adjust the Sweep Oscillator and Network Analyzer controls to phase lock the Network Analyzer over the frequency band of interest.
4. Push and hold the 8414A beam center pushbutton and adjust the centering controls to place the dot in the center of the polar display.
5. Obtain equal reference and test channel electrical lengths by adjusting the REFERENCE PLANE EXTENSION to collapse the trace to a dot or smallest cluster. If the digital counter is to be used to determine the electrical length of the device under test, it should be set to zero. A convenient way to do this is as follows:
    a. Adjust REFERENCE PLANE EXTENSION crank until counter reads all zeros.
    b. Hold thumbwheel to retain zero indication and readjust REFERENCE PLANE EXTENSION to collapse the trace to a dot or smallest cluster.
6. Adjust the 8410A phase and amplitude controls to place the dot or cluster for a reference indication of $\Gamma=1\,\underline{/0^\circ}$

MEASUREMENT

1. Insert the device to be tested between the UNKNOWN port and the 10-dB attenuator.
2. Note the 8410A test channel gain setting. This is the calibrated gain setting. Adjust the test channel gain controls to locate the CRT display on the outside ring. The difference in test channel gain settings is the magnitude of the transmission gain or loss of the device under test.
3. To determine the electrical length of the device under test perform the following:
    a. Adjust the REFERENCE PLANE EXTENSION to again collapse the trace to a dot or smallest cluster.
    b. The electrical length of the device under test is two times the digital counter reading.

Figure 3-6. Transmission Measurements, Using Network Analyzer with 8414A Polar Display Unit (Sheet 2 of 2)

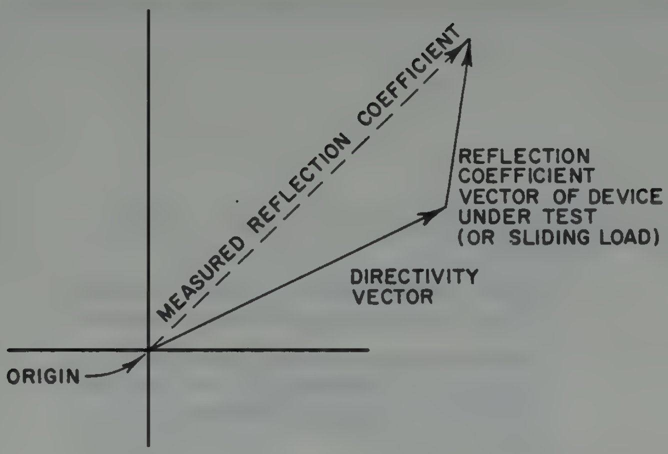

MEASURED REFLECTION COEFFICIENT
REFLECTION COEFFICIENT VECTOR OF DEVICE UNDER TEST (OR SLIDING LOAD)
DIRECTIVITY VECTOR
ORIGIN

Figure 3-7. Measured Reflection Coefficient.

3-13. INCREASED ACCURACY FOR REFLECTION MEASUREMENTS BY MINIMIZING DIRECTIVITY ERRORS.

3-14. The 8743A internal coupler's directivity errors become significant when measuring small reflection coefficients, but the error can be cancelled at single frequencies. The measured reflection is the vector sum of the directivity vector plus the reflection coefficient of the device under test. (See Figure 3-7.) The error is calibrated out with a sliding load. Figure 3-8 depicts the sliding load in one position at a single-frequency. As the sliding load is moved, the magnitude of its reflection coefficient remains constant but the phase of the coefficient changes. As the load is moved its reflection coefficient indication rotates in a circle of constant magnitude about the directivity vector. The center of this circle is the tip of the directivity vector. If the magnitude of the directivity was zero, the locus circle would be centered about the origin as shown in Figure 3-9. The directivity vector goes from the origin to the center of the locus circle. When the location of the center of the circle is known, the directivity vector can be subtracted from the measured reflection. The resultant is the reflection coefficient of the device under test.

3-15. The vector subtraction can be performed directly with the horizontal and vertical controls on the 8414A polar display. Increase the 8410A TEST CHANNEL GAIN so full scale reflection on the polar display is suitable for the component you wish to measure. Attach a sliding load such as the HP 905A to the 8743A UNKNOWN port. Slide the load and adjust the horizontal and vertical controls until the circle rotates about the center of the CRT. The effect of directivity is now cancelled for this frequency and this test channel gain on the Network Analyzer. The vector subtraction must be done manually with the 8413A. Put the sliding load on the 8743A and measure reflection, phase and magnitude, for three positions of the sliding load. Plot these three points on graph paper and find the center of the circle that goes through these points. The vector from the orgin of the graph to this center must be vectorically subtracted from any reflection measurement at this frequency.

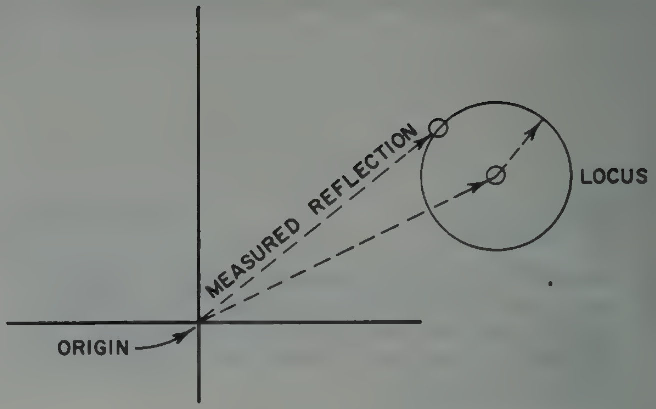


Figure 3-8. Locus of Measured Reflection when Load is Moved.

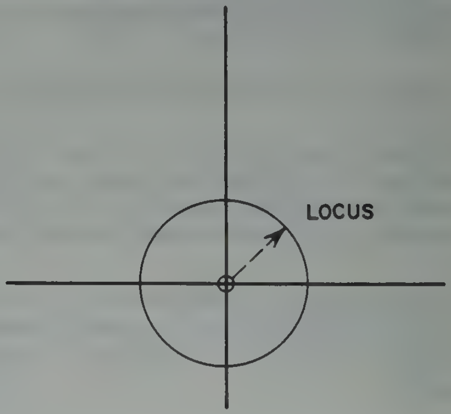


Figure 3-9. Locus of Measured Reflection with Directivity Cancelled

3-16. INCREASED ACCURACY FOR TRANSMISSION MEASUREMENTS BY REDUCING MISMATCH AMBIGUITY.

3-17. A 50-ohm coaxial attenuator is recommended for transmission measurements. An attenuator connected between the output of the device under test and the HP 11605A Flexible Arm reduces the ambiguity due to mismatch between the 11605A, 8743A and 8411A. A 10-dB low-reflection attenuator, such as a HP 8492A Option 10 reduces this ambiguity to essentially that due to the mismatch of the attenuator (VSWR < 1.25). Other values of attenuation may be used; however, values greater than 10 dB will not reduce the mismatch below that of the attenuator. For values less than 10 dB the multiple mismatch between the 11605A, 8743A and 8411A should be taken into consideration. In addition to reducing ambiguity due to mismatch, the 10-dB attenuator makes the test channel power level during calibration the same for transmission and reflection. Also, the combined electrical lengths of the 8492A and the 11605A makes the electrical length of the test channel in the transmission mode nearly equal to its length in the reflection mode. This means that, since the difference is small, it is possible to calibrate for one mode of operation, and switch to the other without recalibrating.

Table 3-1. Contact Closures for Remote Operation.

J1 Pin No.	Function
1 thru 16	No connection
17	Remote-Manual Select
18	Remote Control Common
19 thru 23	No Connection
24	Remote TRANS-REFL Select
25	No Connection
36	Remote Control Common

3-18. REMOTE OPERATION.

3-19. A thirty-six pin connector on the rear panel of the 8743A provides contacts for remote selection of transmission or reflection measurements. Only four of the thirty-six pins are used. The pins and their uses are given in Table 3-1. When remote-manual select pin 17 is open and not connected to a remote control common (pin 18 or 36), the 8743A is in the manual or front panel mode. In this mode of operation, the front-panel pushbuttons are enabled and remote TRANS-REFL select pin 24 is disabled. When remote-manual select pin 17 is connected to a remote control common (pin 18 or 36), the 8743A is in the remote mode. In this mode of operation the front-panel pushbuttons are disabled, and remote TRANS-REFL select pin 24 is enabled, allowing selection of transmission or reflection measurements only through the remote input pin 24. Table 3-2 shows the signal requirements for remote operation. A typical transistor remote control circuit is shown in Figure 3-10. The 8743A supplies approximately +12 Vdc for the open-circuit condition and 12 mA of current for the short-circuit condition.

3-20. CARE OF APC-7 CONNECTORS.

3-21. RF connections to and from the device under test and to the phase-amplitude ratio indicator are made with APC-7 style 50-ohm 7 mm sexless connectors. These connectors should be handled with partiular care for two reasons:

a. Continuity through APC-7 connectors is obtained by end-to-end contact of the inner and outer conductors. Consequently, the electrical performance of the connector is largely dependent upon the condition of these exposed surfaces.

b. The inner conductor of the front-panel UNKNOWN connector is attached to a directional coupler and any rotational force on the inner conductor may result in damage to the coupler.

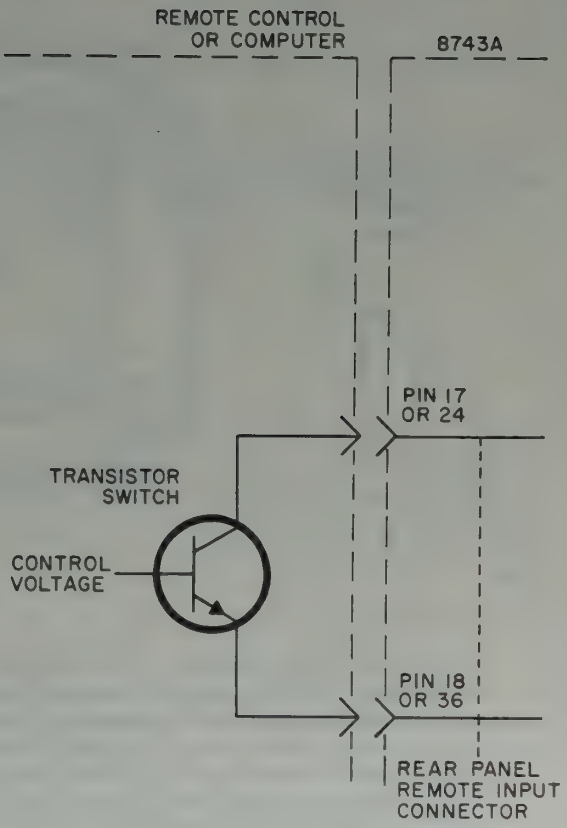


Figure 3-10. Typical Transistor Remote Control Circuit.

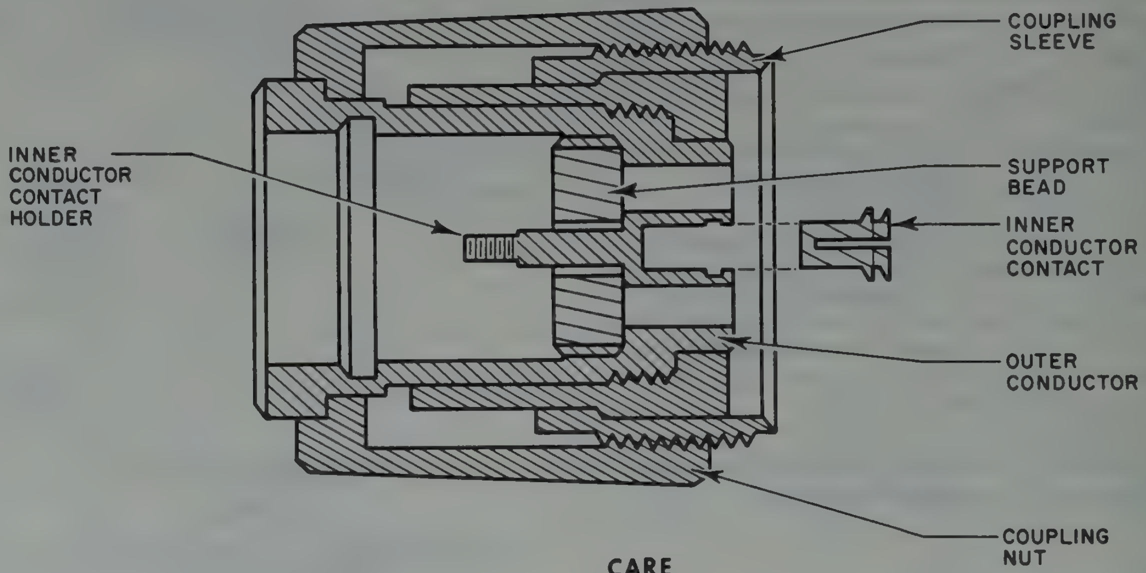
Table 3-2. Signal Requirements for Remote Operation.

Measurement	Pin 18 or 36 to:	
	Pin 17	Pin 24
Transmission	shorted	shorted
Reflection	shorted	open

3-22. Important recommendations about the handling and care of the APC-7 connectors are given in Figure 3-11. The part of an input connector that is most likely to be damaged is the inner conductor contact. Since it protrudes slightly beyond the plane of electrical contact, any wiping action of one connector across the other can damage the contact enough to cause a discontinuity. The risk of this kind of damage can be minimized, as stated in Figure 3-11, by always having the coupling sleeves of the UNKNOWN and TRANSMISSION RETURN connectors fully extended.

3-23. CONTACT REPLACEMENT.

3-24. Replacement inner conductor contacts are available from Hewlett-Packard (part number 1250-0907), and from Amphenol RF Division, Danbury, Connecticut (part number 131-129).



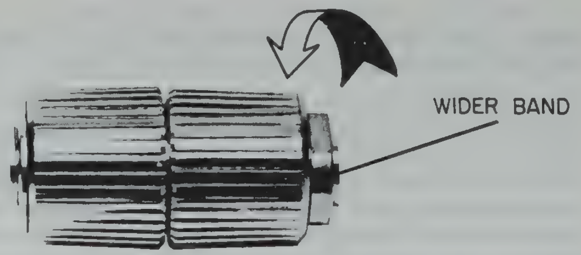
USE

To Connect:

1. On one connector, retract the coupling sleeve by turning the coupling nut counterclockwise until the sleeve and nut disengage.
2. On the other connector, fully extend the coupling sleeve by turning the coupling nut clockwise. To engage coupling sleeve and coupling nut when the sleeve is fully retracted, press back lightly on the nut while turning it clockwise.
3. Push the connectors firmly together, and thread the coupling nut of the connector with retracted sleeve over the extended sleeve. Leave the other coupling nut in the original position: closing the gap between coupling nuts tends to loosen the electrical connection.

To Disconnect:

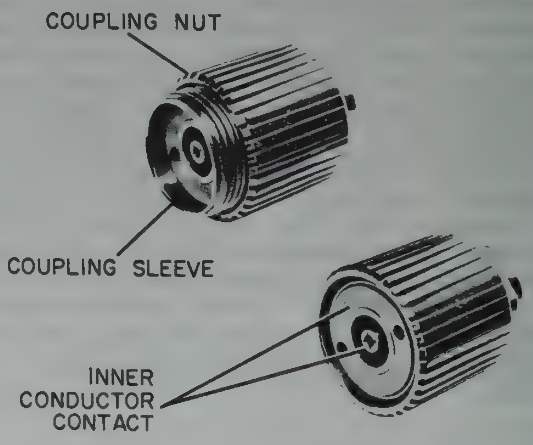
1. Loosen the coupling nut of the connector showing the wider gold band.



2. IMPORTANT: Part the connectors carefully to prevent striking the inner conductor contact.

CARE

1. Keep contacting surfaces smooth and clean. Irregularities and foreign particles can degrade electrical performance.



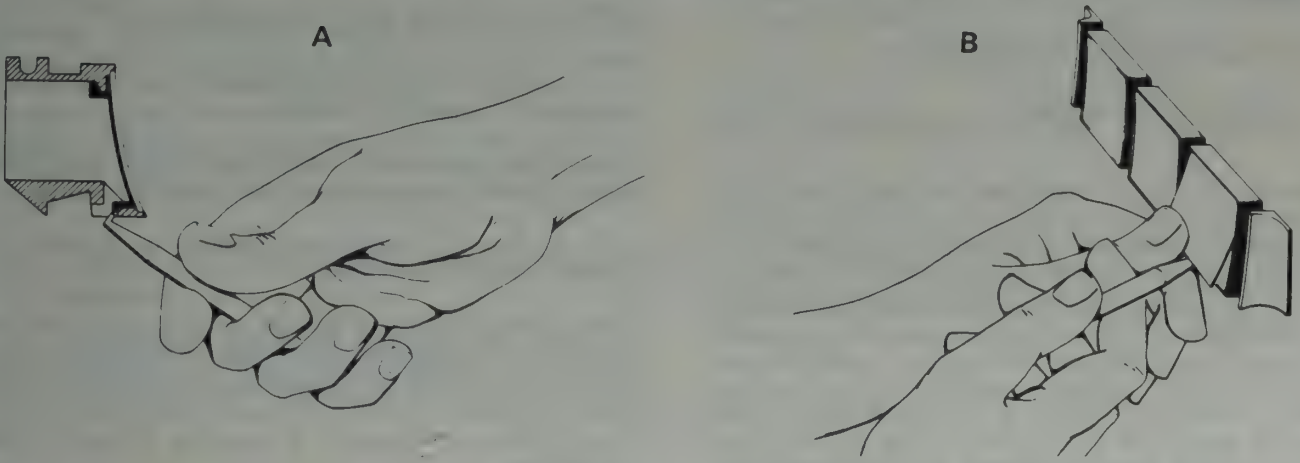
2. Protect the contacting surfaces when the connector is not in use by leaving the coupling sleeve extended.
3. Use lintless material and/or firm-bristled brush such as tooth brush for cleaning. If a cleaning fluid is needed use isopropyl alcohol. IMPORTANT: Do not use aromatic or chlorinated hydrocarbons, esters, ethers, terpenes, higher alcohols, ketones, or ether-alcohols such as benzene, toluene, turpentine, dioxane, gasoline, cellosolve acetate, or carbon tetrachloride. Keep exposure of the connector parts to both the cleaning fluid and its vapors as brief as possible.

Figure 3-11. APC-7 Connectors

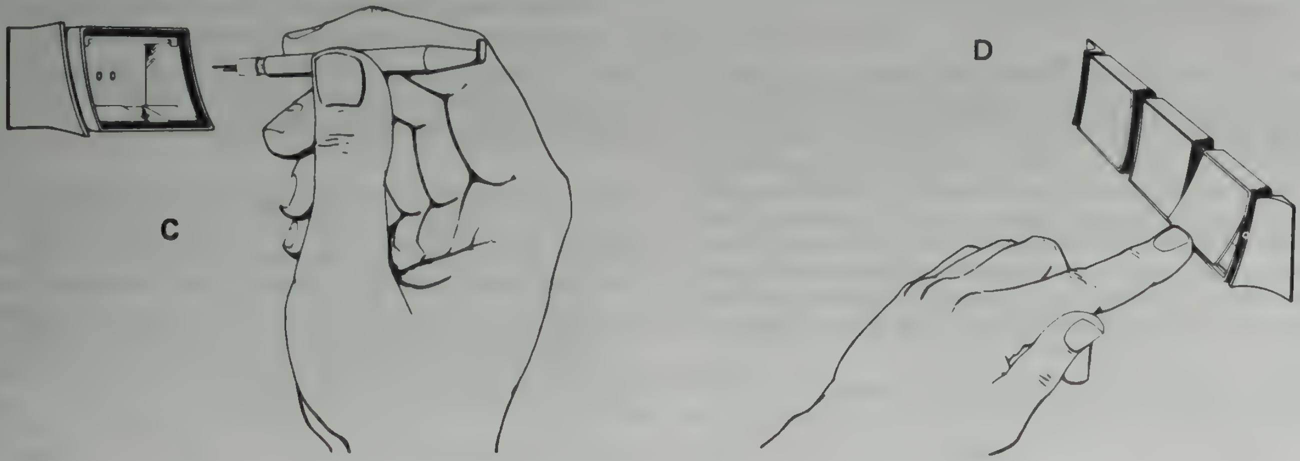
A bulb extractor tool, HP Part No. 4040-0427, has been developed to facilitate bulb replacement for backlighted pushbutton switches of the type shown below.

BULB REPLACEMENT PROCEDURE

1. Place the end of the thumb of one hand over the corner of the pushbutton switch. With the bulb extractor tool in the other hand, place the hooked end of the tool into the front of the slot on the bottom of the pushbutton (A) and gently push up until the lower end of the pushbutton lens pops out as shown in B.



2. Remove the pushbutton lens. Place the hollow end of the bulb extractor tool over the bulb to be replaced and gently pull back. The bulb should stick in the extractor and come out of its socket as the extractor is pulled back as shown in C.



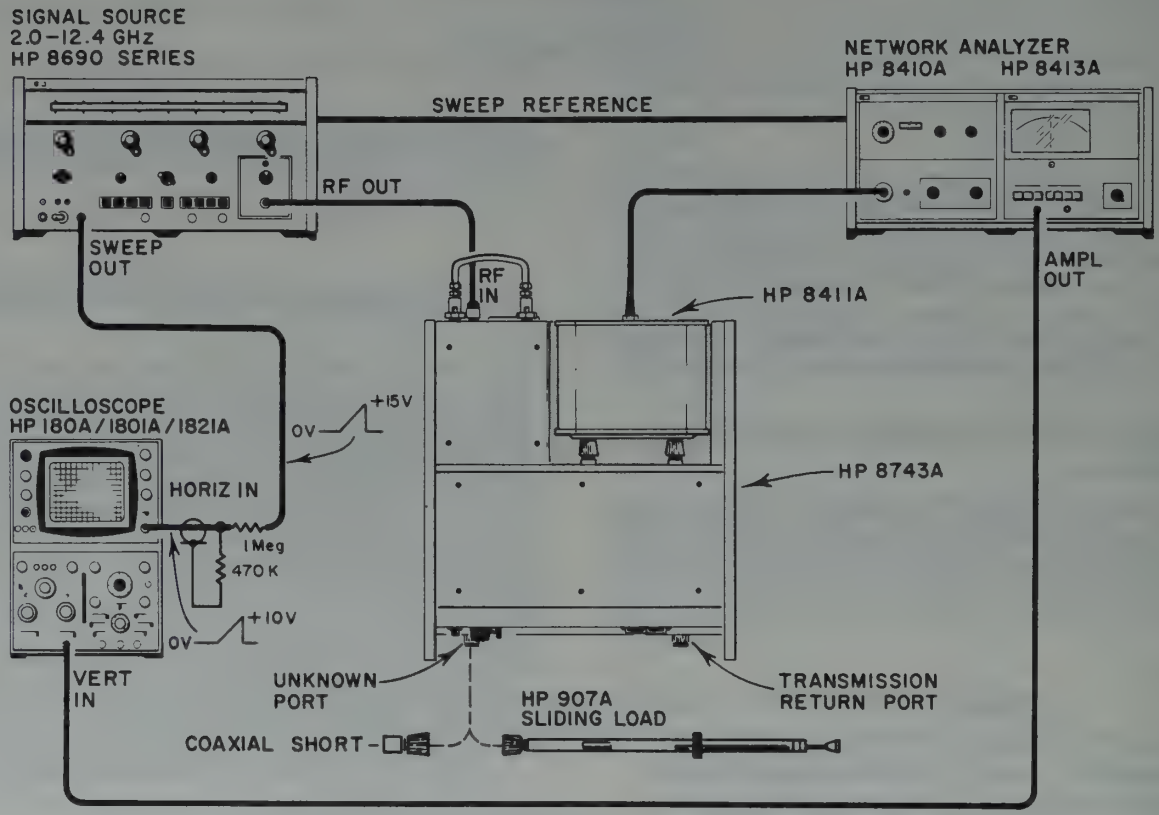
3. Remove the old bulb from the hollow end of the extractor and insert the bulb into the hollow end. Using the extractor to hold the new bulb, insert the new bulb into the socket. To separate bulb and extractor, gently twist until it easily slips off the bulb.
4. Replace the pushbutton lens by first positioning the tabs at the top of the lens into the top of the pushbutton and pressing the bottom of the lens into place as shown in D.

NOTE

Only the pushbutton lens should be removed for bulb replacement. If the pushbutton is inadvertently pulled out during replacement, remove lens from the pushbutton. Re-insert the pushbutton into the front panel and push in until pushbutton snaps in place. Remainder of procedure is the same as previously given.

Figure 3-12. Pushbutton Selector Bulb Replacement

DIRECTIVITY TEST



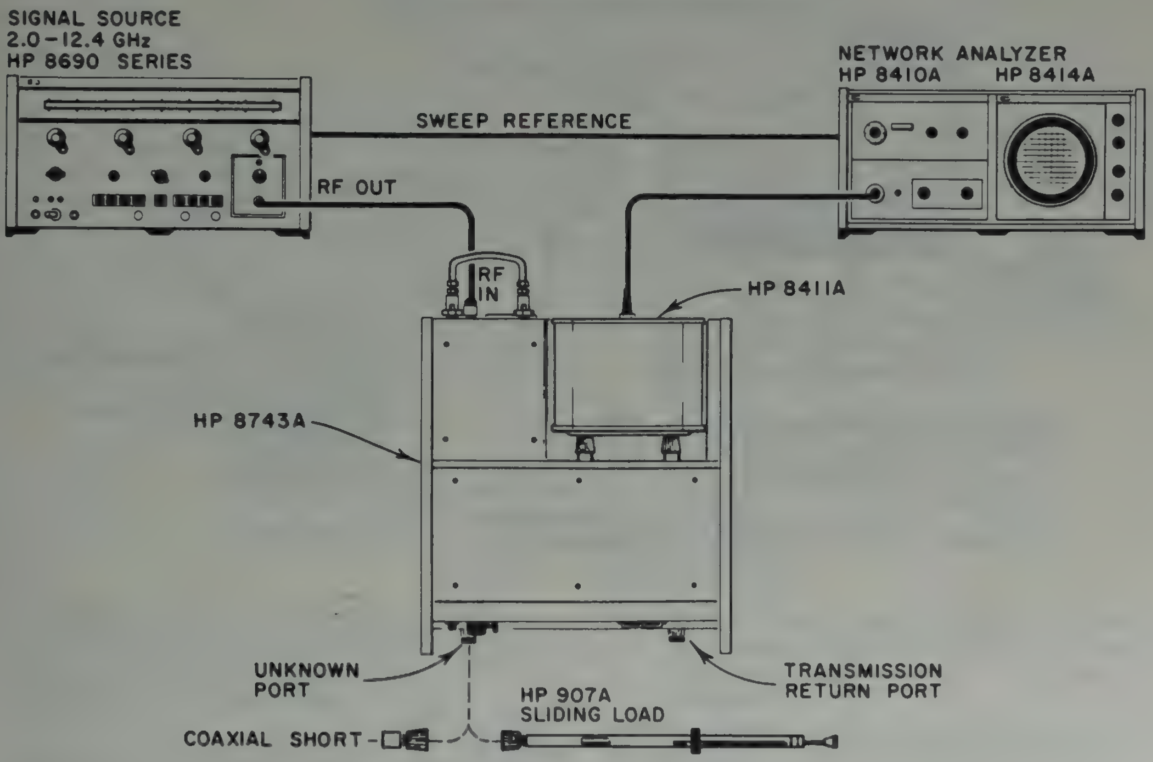
DESCRIPTION: The accuracy of a reflection measurement is affected primarily by the directivity of the coupler monitoring reflected signal. This test measures the directivity of the directional coupler associated with the UNKNOWN port. The test consists of measuring the combination of coupler directivity and load reflection. The load reflection is canceled, and the resultant is directivity. Two procedures are given for making the test. One using the 8413A display unit and the other using the 8414A display unit.

PROCEDURE, Using 8413A Display Unit

1. Connect equipment as shown in setup above.
2. Connect the coaxial short to the 8743A UNKNOWN port and depress the REFL pushbutton.
3. Set the sweep oscillator to automatic sweep. Adjust the sweep oscillator and network analyzer controls to phase lock the network analyzer over the segment of the 8743A frequency range covered by the sweep oscillator.
4. Set the 8410A test channel gain to 20 dB. Adjust the 8410A amplitude vernier and oscilloscope vertical position controls for a convenient amplitude reference on the oscilloscope. Draw the average of this trace on the CRT with a grease pencil.
5. Remove the coaxial short and replace with the sliding load.
6. Increase the 8410A test channel gain by 30 dB. Phase the sliding load, noting oscilloscope display. The average of this display must be below the reference level established in step 4.
7. Repeat steps 2 through 6 for other frequency segments as necessary to cover the range of 2.0 to 12.4 GHz.

Figure 4-1. Performance Test (Sheet 1 of 4)

DIRECTIVITY TEST (Cont.)

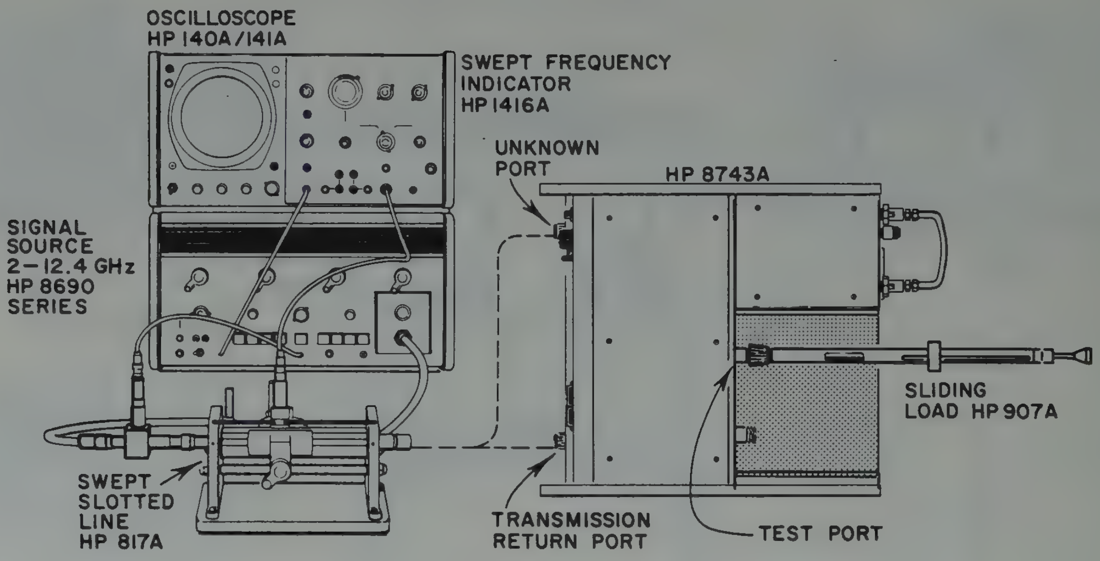


PROCEDURE, Using the 8414A Display Unit

1. Connect equipment as shown in setup above.
2. Connect the coaxial short to the 8743A UNKNOWN port and depress the REFL pushbutton.
3. Set the sweep oscillator to automatic sweep. Adjust the sweep oscillator and network analyzer controls to phase lock the network analyzer over the segment of the 8743A frequency range covered by the sweep oscillator.
4. Push and hold the 8414A BEAM CTR pushbutton and adjust the centering controls to place the dot in the center of the polar display.
5. Adjust the REFERENCE PLANE EXTENSION to collapse the trace to a dot or smallest cluster.
6. Adjust the 8410A test channel gain and amplitude vernier controls to place the dot or the center of the cluster at the outer graticule.
7. Remove the coaxial short and replace with the sliding load.
8. Increase the 8410A test channel gain by 30 dB. Phase the sliding load, noting the CRT display. The average of this display must be inside the outer circle.
9. If the swept-display cannot be resolved satisfactorily, make single-frequency measurements as follows:
   a. Set the sweep oscillator to single-frequency operation. Select the frequency which corresponds to the point of greatest reflection on the 8414A display.
   b. Adjust the 8414A centering controls, while phasing the load, until the circle rotates about the center of the CRT. (See Figure 3-9.)
   c. Depress the 8414A beam center pushbutton. The dot must be inside the outer circle.
10. Repeat steps 2 through 9 for other frequency segments as necessary to cover the range of 2.0 to 12.4 GHz.

Figure 4-1. Performance Test (Sheet 2 of 4)

REFLECTION COEFFICIENT TEST



1. Use a Swept Slotted Line in the setup shown above (with 8743A TEST port terminated in a low-reflection 50-ohm termination) to measure the reflection coefficient of the 8743A TRANSMISSION RETURN port from 2.0 to 12.4 GHz in both the transmission and reflection mode. The maximum peak-to-peak oscilloscope display for each mode must not exceed 2.93 dB (VSWR 1.4).
2. Measure the UNKNOWN port equivalent source reflection coefficient as follows:

DESCRIPTION

The equivalent source reflection coefficient is tested by measuring the change in magnitude of a maximum reflection when the phase of the reflection is varied. The measured change in magnitude is the vector sum of coupler directivity and source reflection; therefore, the equivalent source reflection is actually less than specified.

PROCEDURE

a. Connect equipment to make a reflection measurement as shown in Figure 3-3.

b. Connect a coaxial short such as the HP 11565A to the 8743A UNKNOWN port and depress REFL pushbutton.

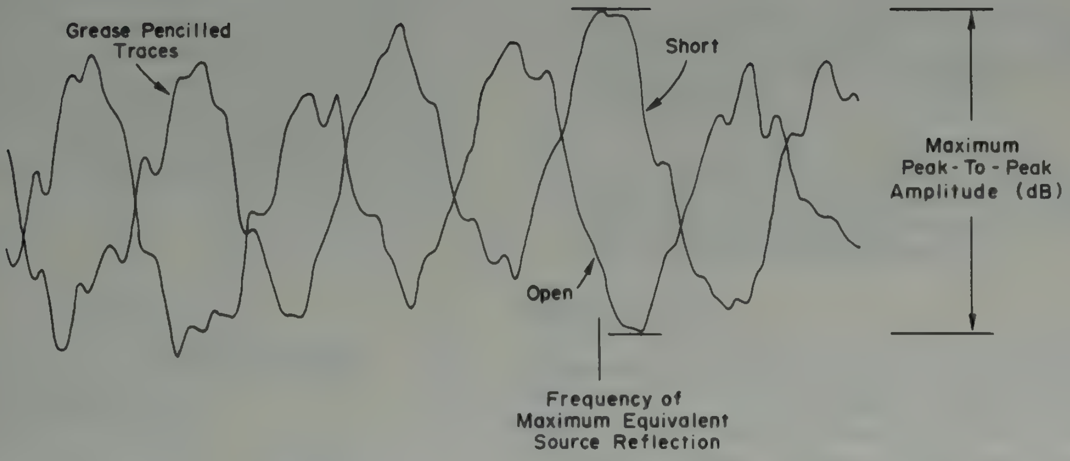
c. Set the Sweep Oscillator to automatic sweep. Adjust the Sweep Oscillator and Network Analyzer controls to phase lock the Network Analyzer over a full octave band in the 2.0 to 12.4 GHz range.

d. Disconnect oscilloscope vertical input from 8413A amplitude channel, to simulate zero volts dc from 8413A. Adjust trace position to the center of the CRT.

e. Reconnect vertical input and adjust 8410A test channel gain and amplitude vernier controls so that the average of the trace falls on the zero trace position noted in step (d).

Figure 4-1. Performance Test (Sheet 3 of 4)

REFLECTION COFFICIENT TEST


Grease Pencilled Traces
Short
Maximum Peak-To-Peak Amplitude (dB)
Open
Frequency of Maximum Equivalent Source Reflection

f. Increase oscilloscope vertical sensitivity to obtain a maximum amplitude CRT presentation. Draw the trace on the face of the CRT with a grease pencil.

g. Remove the coaxial short from the UNKNOWN port and grease pencil the trace of the open circuit on the CRT.

h. Determine the maximum peak-to-peak amplitude as shown above.

(1) Set the Sweep Oscillator to manual operation and adjust Sweep Oscillator manual frequency control and Network Analyzer amplitude vernier control to place the oscilloscope dot at one peak of the grease pencil trace. Note the 8413A meter indication. Place the dot at the other peak and again note the 8413A meter indication. The dB difference between the two meter indications is the peak-to-peak amplitude of the oscilloscope traces.

i. The maximum peak-to-peak amplitude must not exceed 1.59 dB (VSWR $\leq$ 1.2) from 2 to 8 GHz or 2.29 dB (VSWR $\leq$ 1.3) from 8 to 12.4 GHz.

VSWR = antilog 0.05 (peak-to-peak amplitude in dB)

NOTE

This procedure determines the equivalent source reflection for the frequency at which the maximum peak-to-peak amplitude occurs. To determine the equivalent source reflection at other frequencies, repeat steps b through i for other relative phase relations of the load, directivity, and source reflection vectors (i.e., offset the coaxial short using various lengths of air lines).

j. Repeat steps b through i for other frequency bands to cover the range of 2.0 to 12.4 GHz.

Figure 4-1. Performance Test (Sheet 4 of 4)

RF TROUBLESHOOTING

Introduction.

8743A RF troubles can be divided into two general categories, repeatability and insertion loss. Repeatability problems are generally caused by the RF coaxial switches, and insertion loss problems are generally caused by connectors or cables. Because the troubleshooting approach for each of these problems is different, this service note discusses each category separately.

Repeatability.

> NOTE
>
> Repeatability is a supplemental performance characteristic and not an instrument specification.

Repeatability is the change in insertion loss when the coaxial switches are cycled and is normally not a factor in measurement accuracy. The change in 8743A insertion loss when the coaxial switches are cycled is typically less than 0.2 dB. When the equipment is calibrated in one mode of operation and reflection and transmission measurements are both made without recalibrating, repeatability can degrade measurement accuracy. For best accuracy the equipment should be calibrated and measurements made in one mode of operation to keep insertion loss the same for both calibration and measurement.

Repeatability problems are generally due to the center conductor flipper inside the switch not making contact with the same pressure each time the switch is cycled. To isolate a repeatability problem to a single switch, use the following procedure.

Transmission Check. Setup the 8743A, Network Analyzer, and Display Unit to calibrate for a transmission measurement (connect a through section between the 8743A UNKNOWN and TRANSMISSION RETURN ports). Cycle the coaxial switches by alternately pressing the TRANS and REFL pushbuttons while observing the transmission display for repeatability.

Reflection Check. Setup the 8743A, Network Analyzer, and Display Unit to calibrate for a reflection measurement (connect a coaxial short to the 8743A UNKNOWN port). Cycle the coaxial switches by alternately pressing the TRANS and REFL pushbuttons while observing the display for repeatability. Determine the faulty switch as follows:

1. If a repeatability problem occurred in both the REFLECTION and TRANSMISSION checks, replace A6 Test Port Relay Assembly (HP Part No. 08743-60009.
2. If a repeatability problem occured in the RELFECTION check only, replace A5 Unknown Port Relay Assembly (HP Part No. 08743-60011).
3. If a repeatability problem occurred in the TRANSMISSION check only, replace A7 Transmission Return Port Relay Assembly (HP Part No. 08743-60010).

Insertion Loss.

Insertion loss problems are generally caused by a discontinuity in a connector or cable. The indication that a problem may exist is an increase or decrease in the Network Analyzer's displayed magnitude at one or more frequencies during calibration. The Network Analyzer displays the ratio of reference channel to test channel power; therefore, a loss of power in the reference channel will appear on the display as an increase in test channel power. The direction of a spike in the displayed trace isolates the trouble to either the reference or test channel. Generally a discontinuity will show up at higher frequencies; therefore, troubleshooting should be done in X-band and then the instrument should be checked over the remaining operating range. To isolate an insertion loss problem, perform the troubleshooting procedure in Figure 4-2.

COAXIAL SWITCH REPLACEMENT PROCEDURE.

Removal. To remove the A5, A6, and A7 Assemblies:

1. Remove the 8743A top and bottom covers.
2. Remove circuit board assemblies A1 and A3.
3. Remove cable W7 as follows:
   a. Remove the large thin nut securing the TEST output connector to the sub-deck.
   b. Disconnect W7 from the A6 Assembly using a 3/4 inch open-end wrench, and slide as much of the cable as possible through the hole in the sub-deck.
4. Loosen W6 and W9's connectors to the A5 and A7 assemblies using a 3/4 inch open-end wrench.

5. Unsolder the white and green wires (which come through the deck) from the A5 Assembly.

6. Remove the six coaxial switch mounting screws accessible from the bottom of the instrument.

7. Remove the A5, A6, and A7 Assemblies from the instrument as one unit.

8. Disconnect the switch to be replaced and unsolder the appropriate white and green wires. Mark the wires so they may be soldered to the proper terminals on the new switch.

Installation. To install the A5, A6, and A7 Assemblies:

1. Assemble the three coaxial switches into one unit.

2. Solder the white and green wires removed in step 8 of the removal procedure.

3. Insert the A5, A6, and A7 Assemblies into the 8743A as one unit. Do not install mounting screws.

4. Connect cables W6 and W9 to the appropriate switches and tighten each connector.

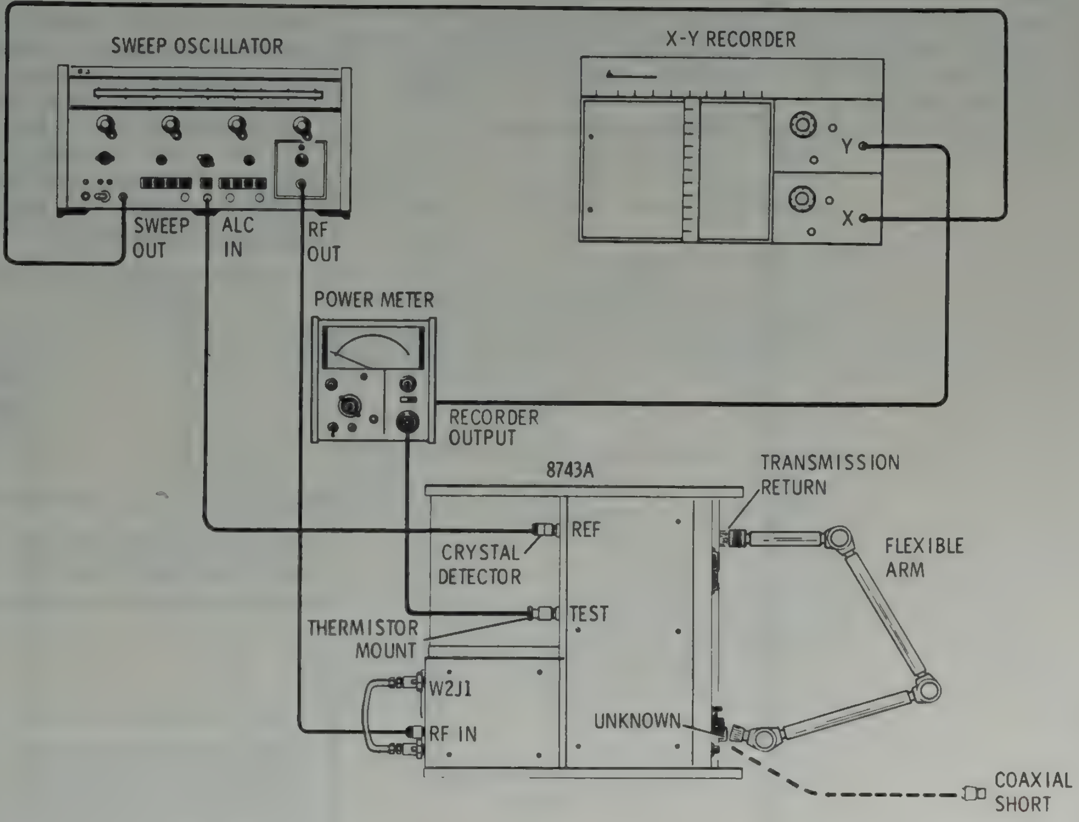
5. Connect cable W7 to the A6 Assembly and tighten connector.

6. Install the large thin securing nut to the TEST output connector.

7. Install the six coaxial switch mounting screws. Insure that green and white wires are not routed or pinched between switches and mounting deck.

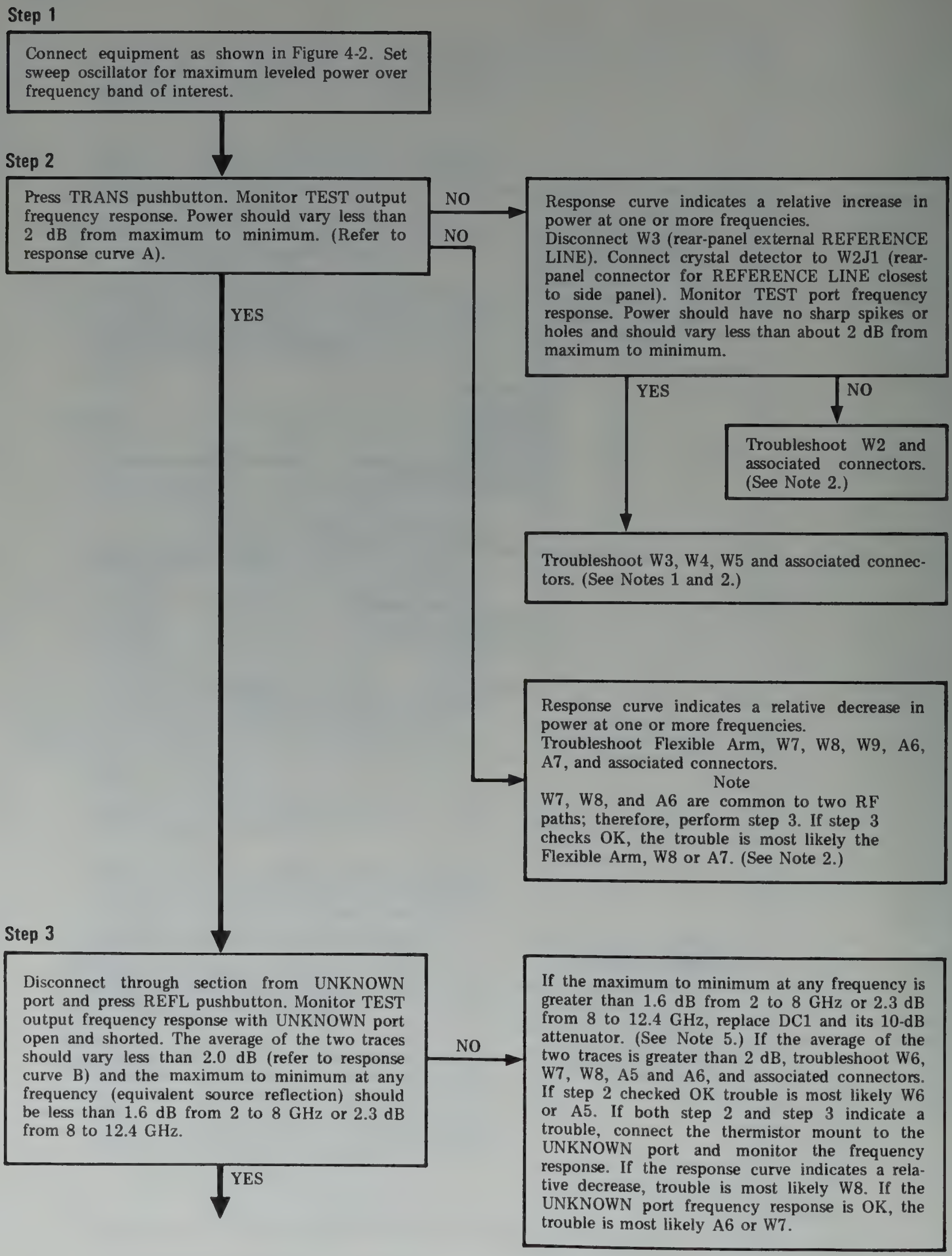
8. Solder the wires removed in step 5 of the removal procedure, matching wire colors to the wires previously installed.

9. Perform the insertion loss troubleshooting procedure in Figure 4-2. If sharp power variations occur during any check, vary the torque on each coaxial switch connector, while observing the frequency response curve, until power variation is minimum.



SWEEP OSCILLATOR	HP 8690 Series with RF unit as required
POWER METER	HP 432A
THERMISTOR MOUNT	HP 8478B, Option 11
X-Y RECORDER	HP 7035B
CRYSTAL DETECTOR	HP 8470A
FLEXIBLE ARM	HP 11605A
COAXIAL SHORT	HP 11565A

Figure 4-2. Insertion Loss Troubleshooting (Sheet 1 of 4)



Step 1

Connect equipment as shown in Figure 4-2. Set sweep oscillator for maximum leveled power over frequency band of interest.

Step 2

Press TRANS pushbutton. Monitor TEST output frequency response. Power should vary less than 2 dB from maximum to minimum. (Refer to response curve A).

Response curve indicates a relative increase in power at one or more frequencies. Disconnect W3 (rear-panel external REFERENCE LINE). Connect crystal detector to W2J1 (rear-panel connector for REFERENCE LINE closest to side panel). Monitor TEST port frequency response. Power should have no sharp spikes or holes and should vary less than about 2 dB from maximum to minimum.

Troubleshoot W2 and associated connectors. (See Note 2.)

Troubleshoot W3, W4, W5 and associated connectors. (See Notes 1 and 2.)

Response curve indicates a relative decrease in power at one or more frequencies. Troubleshoot Flexible Arm, W7, W8, W9, A6, A7, and associated connectors.

Note

W7, W8, and A6 are common to two RF paths; therefore, perform step 3. If step 3 checks OK, the trouble is most likely the Flexible Arm, W8 or A7. (See Note 2.)

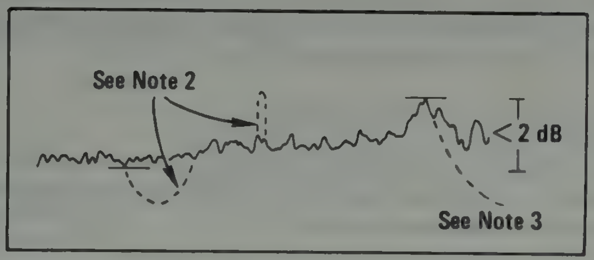
Step 3

Disconnect through section from UNKNOWN port and press REFL pushbutton. Monitor TEST output frequency response with UNKNOWN port open and shorted. The average of the two traces should vary less than 2.0 dB (refer to response curve B) and the maximum to minimum at any frequency (equivalent source reflection) should be less than 1.6 dB from 2 to 8 GHz or 2.3 dB from 8 to 12.4 GHz.

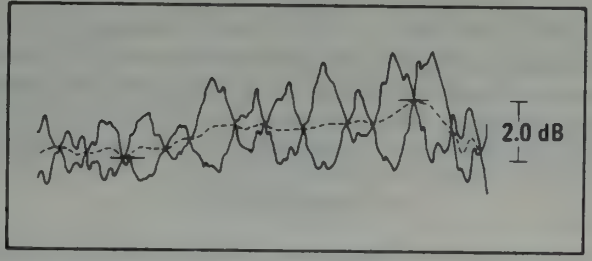
If the maximum to minimum at any frequency is greater than 1.6 dB from 2 to 8 GHz or 2.3 dB from 8 to 12.4 GHz, replace DC1 and its 10-dB attenuator. (See Note 5.) If the average of the two traces is greater than 2 dB, troubleshoot W6, W7, W8, A5 and A6, and associated connectors. If step 2 checked OK trouble is most likely W6 or A5. If both step 2 and step 3 indicate a trouble, connect the thermistor mount to the UNKNOWN port and monitor the frequency response. If the response curve indicates a relative decrease, trouble is most likely W8. If the UNKNOWN port frequency response is OK, the trouble is most likely A6 or W7.

Figure 4-2. Insertion Loss Troubleshooting (Sheet 2 of 4)

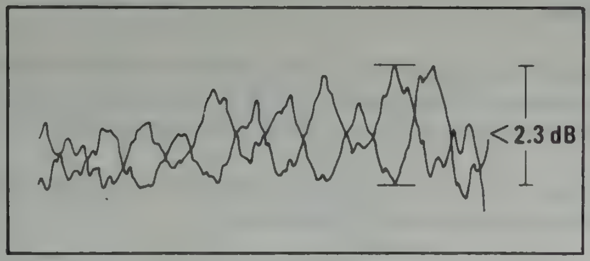
Response Curve A



Response Curve B



Response Curve C



NOTE 1

Reflections from a discontinuity on one side of the line stretcher will combine with reflections in the line stretcher or with reflections from the other side of the line stretcher. The response curve is the resultant of all discontinuities. By changing the line stretcher position, the phase relationship between the sets of reflections changes and the response curve will be altered. Monitor frequency response at several REFERENCE PLANE EXTENSION settings. If the overall power variation is greater than 2 dB at any REFERENCE PLANE EXTENSION setting, the trouble may be in the line stretcher or discontinuities on each side of the line stretcher.

NOTE 2

A relative increase in power indicates a trouble in the reference channel. A relative decrease in power indicates a trouble in the test channel. A narrow spike is most likely caused by poor contact of cable center conductor pins, one finger of a female pin not making contact, or gross outer conductor separation. A power change over a broader frequency range is most likely caused by a cable outer conductor grounding problem. For outer conductor grounding problems on instruments with Serial Numbers 928-00315 and below, disassemble the cable and add a washer (HP Part No. 5000-8676) as shown in Figure 2.

Figure 4-2. Insertion Loss Troubleshooting (Sheet 3 of 4)

NOTE 3

If a cable's center conductor is not centered it may distort a switch's center conductor contact and cause an increase in insertion loss. The increased insertion loss is most likely to occur from 11 to 12.4 GHz (See Response Curve A.)

NOTE 4

Although cable ends appear to be perfect they may still present a discontinuity. Also trimming these cable ends requires special tools. Therefore, if you are unable to eliminate a discontinuity, replace the suspected cable.

NOTE 5

Directional Coupler DC1 (HP Part No. 08743-60005) includes a tuned 10 dB attenuator. If the troubleshooting procedure step 3 indicates a trouble in DC1 the problem could be the 10 dB attenuator. Check the coupler directivity using the Operating and Service Manual Performance Test Procedure. If the directivity is OK the trouble is most likely the 10 dB attenuator. The attenuator may be replaced using the following procedure:

CAUTION

Do not unscrew flat head screws, or brass attenuator housing connector. If the brass parts move, directivity may be degraded.

1. Using a 1/2 inch open end wrench, hold the brass attenuator housing connector to keep it from rotating. Using plastic jawed, or padded vise grip pliers, unscrew the round stainless steel part (not the part with the flats).

2. Remove attenuator cartridge. Do not remove gold plated center conductor contacts. A special tool is required to install these contacts.

3. Install a new attenuator cartridge (HP Part No. 08743-60014) with a washer on each side of the cartridge.

NOTE

The marked end of the cartridge has the lowest reflection and should go into the coupler.

4. Install the round stainless steel part removed in step 1.

Figure 4-2. Insertion Loss Troubleshooting (Sheet 3 of 4)

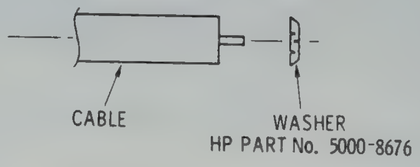


Figure 4-3. Position of Outer Conductor Washer

SECTION V

REPLACEABLE PARTS

5-1. INTRODUCTION.

5-2. This section contains information for ordering replaceable parts. Parts are listed in alpha-numerical order by reference designation together with their HP stock numbers and descriptions.

5-3. ORDERING INFORMATION.

5-4. When ordering a replacement part listed in Table 5-1:

a. Quote the Hewlett-Packard stock number for the part.

b. Address the order or inquiry to the nearest Hewlett-Packard sales and service office listed at the rear of this manual.

5-5. To order a part not listed in the tables:

a. Give a complete description of the part including its function and location.

b. Give the instrument model number and complete serial number.

c. Address the order of inquiry to the nearest Hewlett-Packard sales and service office listed at the rear of this manual.

REFERENCE DESIGNATORS

A = assembly
B = motor
BT = battery
C = capacitor
CP = coupler
CR = diode
DL = delay line
DS = device signaling (lamp)
E = misc electronic part

F = fuse
FL = filter
IC = integrated circuit
J = jack
K = relay
L = inductor
LS = loud speaker
M = meter
MK = microphone

MP = mechanical part
P = plug
Q = transistor
R = resistor
RT = thermistor
S = switch
T = transformer
TB = terminal board
TP = test point

V = vacuum, tube, neon bulb, photocell, etc.
VR = voltage regulator
W = cable
X = socket
Y = crystal
Z = tuned cavity, network

ABBREVIATIONS

A = amperes
AFC = automatic frequency control
AMPL = amplifier

BFO = beat frequency oscillator
BE CU = beryllium copper
BH = binder head
BP = bandpass
BRS = brass
BWO = backward wave oscillator

CCW = counter-clockwise
CER = ceramic
CMO = cabinet mount only
COEF = coefficient
COM = common
COMP = composition
COMPL = complete
CONN = connector
CP = cadmium plate
CRT = cathode-ray tube
CW = clockwise

DEPC = deposited carbon
DR = drive

ELECT = electrolytic
ENCAP = encapsulated
EXT = external

F = farads
FH = flat head
FIL H = fillister head
FXD = fixed

G = giga (10^9)
GE = germanium
GL = glass
GRD = ground(ed)

H = henries
HDW = hardware
HEX = hexagonal
HG = mercury
HR = hour(s)
HZ = hertz

IF = intermediate freq
IMPG = impregnated
INCD = incandescent
INCL = include(s)
INS = insulation(ed)
INT = internal

K = kilo = 1000

LH = left hand
LIN = linear taper
LK WASH = lock washer
LOG = logarithmic taper
LPF = low pass filter

M = milli = 10^{-3}
MEG = meg = 10^6
MET FLM = metal film
MET OX = metallic oxide
MFR = manufacturer
MHZ = mega hertz
MINAT = miniature
MOM = momentary
MTG = mounting
MY = "mylar"

N = nano (10^{-9})
N/C = normally closed
NE = neon
NI PL = nickel plate

N/O = normally open
NPO = negative positive zero (zero temperature coefficient)
NPN = negative-positive-negative
NRFR = not recommended for field replacement
NSR = not separately replaceable

OBD = order by description
OH = oval head
OX = oxide

P = peak
PC = printed circuit
PF = picofarads = 10^{-12} farads
PH BRZ = phosphor bronze
PHL = Phillips
PIV = peak inverse voltage
PNP = positive-negative-positive

P/O = part of
POLY = polystyrene
PORC = porcelain
POS = position(s)
POT = potentiometer
PP = peak-to-peak
PT = point
PWV = peak working voltage

RECT = rectifier
RF = radio frequency
RH = round head or right hand

RMO = rack mount only
RMS = root-mean square
RWV = reverse working voltage

S-B = slow-blow
SCR = screw
SE = selenium
SECT = section(s)
SEMICON = semiconductor
SI = silicon
SIL = silver
SL = slide
SPG = spring
SPL = special
SST = stainless steel
SR = split ring
STL = steel

TA = tantalum
TD = time delay
TGL = toggle
THD = thread
TI = titanium
TOL = tolerance
TRIM = trimmer
TWT = traveling wave tube

U = micro = 10^{-6}

VAR = variable
VDCW = dc working volts

W/ = with
W = watts
WIV = working inverse voltage
WW = wirewound
W/O = without

Table 5-1. Reference Designation Index

Reference Designation	ⓗ Part No.	Description #	Note
A1	08743-60001	POWER SUPPLY ASSY	
A1C1	0160-2930	C:FXD CER 0.01 UF +80-20% 100VDCW	
A1C2	0180-0141	C:FXD ELECT 50 UF +75-10% 50VDCW	
A1CR1	1901-0026	DIODE:SILICON 0.75A 200PIV	
A1CR2	1901-0026	DIODE:SILICON 0.75A 200PIV	
A1CR3	1901-0026	DIODE:SILICON 0.75A 200PIV	
A1CR4	1901-0026	DIODE:SILICON 0.75A 200PIV	
A1CR5	1901-0200	DIODE:SILICON 3A 100PIV	
A1CR6	1902-3193	DIODE BREAKDOWN:13.3V 5%	
A1Q1	1854-0071	TRANSISTOR:SILICON NPN	
A1Q2	1854-0039	TRANSISTOR:SILICON 2N3053	
A1Q3	1854-0071	TRANSISTOR:SILICON NPN	
A1R1	0698-3640	R:FXD MET OX 1.8K OHM 5% 2W	
A1R2	0757-0421	R:FXD MET FLM 825 OHM 1% 1/8W	
A1R3	0757-0199	R:FXD MET FLM 21.5K OHM 1% 1/8W	
A1R4	0811-1672	R:FXD WW 3.3 OHM 5% 2W	
A1R5	0698-3154	R:FXD MET FLM 4.22K OHM 1% 1/8W	
A1R6	0757-0438	R:FXD MET FLM 5.11K OHM 1% 1/8W	
A1R7	2100-1758	R:VAR WW 1K OHM 10% LIN 1/2W	
A2	08743-60002	SWITCH ASSY	
A2CR1	1901-0025	DIODE:SILICON 100WV 100MA	
A2CR2	1901-0025	DIODE:SILICON 100WV 100MA	
A2DS1	2140-0213	LAMP:INCANDESCENT 28V 0.04A	
A2DS2	2140-0213	LAMP:INCANDESCENT 28V 0.04A	
A2Q1	1854-0071	TRANSISTOR:SILICON NPN	
A2Q2	1854-0071	TRANSISTOR:SILICON NPN	
A2R1	0757-0438	R:FXD MET FLM 5.11K OHM 1% 1/8W	
A2R2	0698-3450	R:FXD MET FLM 42.2K OHM 1% 1/8W	
A2R3	0757-0438	R:FXD MET FLM 5.11K OHM 1% 1/8W	
A2R4	0757-0438	R:FXD MET FLM 5.11K OHM 1% 1/8W	
A2R5	0698-3450	R:FXD MET FLM 42.2K OHM 1% 1/8W	
A2R6	0757-0438	R:FXD MET FLM 5.11K OHM 1% 1/8W	
A2R7	0757-1000	R:FXD MET FLM 51.1 OHM 1% 1/2W	
A2S1		NOT SEPARATELY REPLACEABLE	
A2S2		NOT SEPARATELY REPLACEABLE	
A3	08743-60038	RELAY DRIVER ASSY	
A3C1	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
A3CR1	1901-0025	DIODE:SILICON 100WV 100MA	
A3CR2	1901-0025	DIODE:SILICON 100WV 100MA	
A3CR3	1901-0025	DIODE:SILICON 100WV 100MA	
A3CR4	1901-0025	DIODE:SILICON 100WV 100MA	
A3CR5	1901-0025	DIODE:SILICON 100WV 100MA	
A3CR6	1901-0025	DIODE:SILICON 100WV 100MA	
A3CR7	1901-0025	DIODE:SILICON 100WV 100MA	
A3CR8	1901-0025	DIODE:SILICON 100WV 100MA	
A3CR9	1901-0025	DIODE:SILICON 100WV 100MA	
A3CR10	1901-0025	DIODE:SILICON 100WV 100MA	

# See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont.)

Reference Designation	Part No.	Description #	Note
A3CR11	1902-0551	DIODE BREAKDOWN:6.19V 5%	
A3Q1	1854-0039	TRANSISTOR:SILICON 2N3053	
A3Q2	1854-0039	TRANSISTOR:SILICON 2N3053	
A3Q3	1853-0012	TRANSISTOR:SILICON PNP	
A3Q4	1853-0012	TRANSISTOR:SILICON PNP	
A3Q5	1854-0071	TRANSISTOR:SILICON NPN	
A3Q6	1853-0020	TRANSISTOR:SILICON PNP	
A3Q7	1853-0020	TRANSISTOR:SILICON PNP	
A3Q8	1854-0071	TRANSISTOR:SILICON NPN	
A3Q9	1854-0071	TRANSISTOR:SILICON NPN	
A3R1	0698-3408	R:FXD MET FLM 2.15K OHM 1% 1/2W	
A3R2	0698-3408	R:FXD MET FLM 2.15K OHM 1% 1/2W	
A3R3	0757-0199	R:FXD MET FLM 21.5K OHM 1% 1/8W	
A3R4	0757-0443	R:FXD MET FLM 11.0K OHM 1% 1/8W	
A3R5	0698-0084	R:FXD MET FLM 2.15K OHM 1% 1/8W	
A3R6	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
A3R7	0698-0084	R:FXD MET FLM 2.15K OHM 1% 1/8W	
A3R8	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
A3R9	0698-3136	R:FXD MET FLM 17.8K OHM 1% 1/8W	
A3R10	0757-0290	R:FXD MET FLM 6.19K OHM 1% 1/8W	
A3R11	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
A3R12	0757-1078	R:FXD MET FLM 1.47K OHM 1% 1/2W	
A3R13	0698-3406	R:FXD MET FLM 1.33K OHM 1% 1/2W	
A3R14	0698-3406	R:FXD MET FLM 1.33K OHM 1% 1/2W	
A3R15	0757-0462	R:FXD MET FLM 75K OHM 1% 1/8W	
A4	08741-60004	LINE STRETCHER ASSY	
A5	08743-60011	RELAY ASSY,UNKNOWN PORT	
A6	08743-60009	RELAY ASSY,TEST PORT	
A7	08743-60010	RELAY ASSY,TRANSMISSION RETURN PORT	
C1	0180-0198	C:FXD ELECT 1500 UF 50/60VDCW	
DC1	08743-60005	DIRECTIONAL COUPLER(TEST)	
DC2	08743-60004	DIRECTIONAL COUPLER(INPUT)	
DS1	2140-0244	LAMP:GLOW	
F1	2110-0336 2110-0340	FUSE:CARTRIDGE 1/2A 250V SLOW-BLOW(115VAC) FUSE:CARTRIDGE 0.25A SLOW-BLOW(230VAC)	
J1	1251-0085	CONNECTOR:FEMALE 36-PIN MINIATURE	
J2	1251-2357	SOCKET:3-PIN(AC POWER)	
Q1	1854-0072	TRANSISTOR:SILICON NPN 2N3054	
R1	0698-3162	R:FXD MET FLM 46.4K OHM 1% 1/8W	
S1	3101-1244	SWITCH:PUSHBUTTON SPDT(AC AND PILOT LIGHT)	
S2	3101-1235	SWITCH:SLIDE DPDT(115/230V AC)	
T1	9100-2728	TRANSFORMER:24.4V	
W1	8120-1348	CABLE ASSY:POWER CORD	
W2	08743-20021	CABLE ASSY:DC2 TO W3	
W3	08745-20064	CABLE ASSY:EXTERNAL REFERENCE LINE	

# See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont.)

Reference Designation	Part No.	Description #	Note
W4	08743-20023	CABLE ASSY:W3 TO A4	
W5	08743-20024	CABLE ASSY:A4 TO A8	
W6	08743-20033	CABLE ASSY:A5 TO DC1	
W7	08743-20026	CABLE ASSY:A6 TO TEST OUTPUT	
W8	08743-20027	CABLE ASSY:DC2 TO UNKNOWN PORT	
W9	08743-20035	CABLE ASSY:A7 TO TRANSMISSION RETURN PORT	
XF1	1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	
		MISCELLANEOUS	
	0370-0770	LENS	
	5000-6469	LABEL:PUSHBUTTON "TRANS"	
	5000-6470	LABEL:PUSHBUTTON "REFL"	
	08743-60014	10 DB ATTENUATOR CARTRIDGE	
		THIS MANUAL IMPLEMENTS A DIFFERENT COLOR SCHEME FOR THE STANDARD INSTRUMENT. COLORS PRIOR TO THIS CHANGE ARE NOW AVAILABLE AS OPTIONS. REFER TO THE LIST BELOW.	
		8743A STANDARD - INDICATES COLOR SCHEME FOR THE 8740A BEGINNING WITH INSTRUMENTS SERIAL PREFIXED 1226. (INCLUDES MINT GRAY FRONT PANEL AND OLIVE GRAY CABINET).	
		8743A OPTION A85 - INDICATES LIGHT GRAY FRONT PANEL.	
		8743A OPTION X95 - INDICATES COLOR SCHEME FOR 8743A PRIOR TO SERIAL PREFIX 1226. (INCLUDES LIGHT GRAY FRONT PANEL AND BLUE-GRAY CABINET).	
	0370-0974	PUSHBUTTON, JADE GRAY(STANDARD)	
	0370-0767	PUSHBUTTON, GRAY(OPT A85, X95)	
	0370-0975	BEZEL:END CAP(LEFT)JADE GRAY(STANDARD)	
	0370-0765	BEZEL:END CAP(LEFT)GRAY(OPT A85, X95)	
	0370-0976	BEZEL:END CAP(RIGHT)JADE GRAY(STANDARD)	
	0370-0766	BEZEL:END CAP(RIGHT)GRAY(OPT A85, X95)	
	5000-8705	SIDE COVER:REAR,OLIVE GRAY(STANDARD)	
	5000-0736	SIDE COVER:REAR,BLUE-GRAY(OPT X95)	
	5000-8707	SIDE COVER:FRONT,OLIVE GRAY(STANDARD)	
	5000-0737	SIDE COVER:FRONT,BLUE-GRAY(OPT X95)	
	5040-0351	BEZEL:COUNTER,MINT GRAY(STANDARD)	
	5040-0204	BEZEL:COUNTER,GRAY(OPT A85, X95)	
	5060-0268	COVER ASSY:BOTTOM,OLIVE GRAY(STANDARD)	
	5060-0228	COVER ASSY:BOTTOM,BLUE-GRAY(OPT X95)	
	5060-8737	RETAINER:HANDLE ASSY,OLIVE GRAY(STANDARD)	
	5060-0766	RETAINER:HANDLE ASSY,BLUE-GRAY(OPT X95)	
	08743-00018	PANEL:REAR,MINT GRAY(STANDARD)	
	08743-00002	PANEL:REAR,LIGHT GRAY(OPT X95)	
	08743-00019	COVER ASSY:TOP,OLIVE GRAY(STANDARD)	
	08743-00004	COVER ASSY:TOP,BLUE-GRAY(OPT X95)	
	08743-00020	TOP COVER:REAR CORNER,OLIVE GRAY(STANDARD)	
	08743-00005	TOP COVER:REAR CORNER,BLUE-GRAY(OPT X95)	
	08743-00021	FILLER PLATE:CENTER,OLIVE GRAY(STANDARD)	
	08743-00006	FILLER PLATE:CENTER,BLUE-GRAY(OPT X95)	
	08743-00022	FILLER PLATE:SIDE,OLIVE GRAY(STANDARD)	
	08743-00007	FILLER PLATE:SIDE,BLUE-GRAY(OPT X95)	

# See introduction to this section for ordering information

Reference Designation	Part No.	Description #	Note
	08743-00024	PANEL:FRONT,MINT GRAY(STANDARD)	
	08743-00013	PANEL:FRONT,LIGHT GRAY(OPT A85, X95)	
	08743-00023	SUB-DECK,OLIVE GRAY(STANDARD)	
	08743-00014	SUB-DECK,BLUE-GRAY(OPT X95)	
	08745-20068	TRIM:LOWER FRAME,MINT GRAY(STANDARD)	
	08745-2019	TRIM:LOWER FRAME,LIGHT GRAY(OPT A85, X95)	
	08745-20069	TRIM:UPPER FRAME,MINT GRAY(STANDARD)	
	08745-2020	TRIM:UPPER FRAME,LIGHT GRAY(OPT A85, X95)	

# See introduction to this section for ordering information

SECTION VI
SCHEMATIC DIAGRAMS

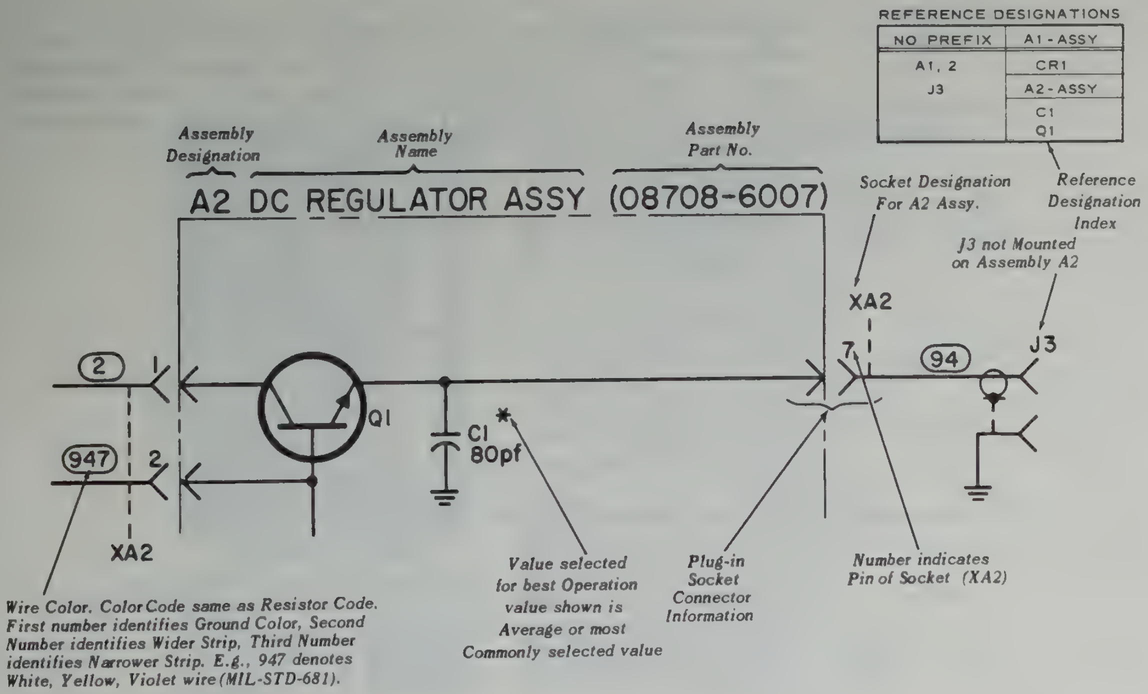
6-1. INTRODUCTION.

6-2. The schematic diagrams in this section represent the circuits electrically. They are not wiring diagrams, though wire colors are given where practical.

6-3. The circuits are arranged according to signal flow; consequently, some switch and circuit assemblies may be shown in part on more than one diagram. If so, the reference designation is preceded by P/O, for "Part Of", and is followed by a notation of the number of parts into which the assembly has been divided.

6-4. Some of the general information obtainable from the schematic diagrams is shown in Figure 6-1. Notes and explanations of symbols pertaining to all the diagrams are contained in Figure 6-2. Notes about specific components, circuits, or conditions are given on the diagram to which they apply.

6-5. As an aid to finding components and assemblies in the set of diagrams, each diagram has a box labelled Reference Designations that contains all the reference designations appearing on the diagram.



Socket Designation For A2 Assy.

Reference Designation Index

J3 not Mounted on Assembly A2

Wire Color. Color Code same as Resistor Code. First number identifies Ground Color, Second Number identifies Wider Strip, Third Number identifies Narrower Strip. E.g., 947 denotes White, Yellow, Violet wire (MIL-STD-681).

Value selected for best Operation value shown is Average or most Commonly selected value

Plug-in Socket Connector Information

Number indicates Pin of Socket (XA2)

Figure 6-1. General Information on Schematic Diagrams

1. Resistance in ohms, capacitance in microfarads unless otherwise noted.

2. Voltages shown on schematic diagrams taken with HP 414A AUTOVOLTMETER: input resistance 100 M Ω, accuracy ±(1% of reading +0.5% of full scale).

3. Unless otherwise indicated on schematic, voltages taken with negative terminal of voltmeter connected to A7TP2.

4. * Asterisk denotes a factory-selected value. Value shown is typical. Part may be omitted.

5. P/O = Part Of.

6. ▭ Encloses front panel designations.

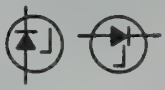
⬚ Encloses rear panel designation.

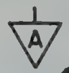
7. ——— — ——— Circuit assembly borderline.

- - - - - - - Other assembly borderline.

8. ❶ Numbers in circles on circuit assemblies show locations of test points. Matching numbers are etched on the circuit assemblies.

9. ▢ Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the ground color, second number the wider stripe, and the third number identifies the narrower stripe. E.G., (947) denotes white ground, yellow wide stripe, violet narrow stripe.

10.  Voltage regulator (breakdown) diode.

11.  Power Supply Common (not chassis ground).

12. Screwdriver adjustment.

13. ○ Panel control.

14. ━━━ ━━━ ━━━ ━━━ Heavy dashed line indicates feedback path.

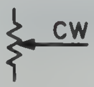
15.  Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.

Figure 6-2. Schematic Diagram Notes

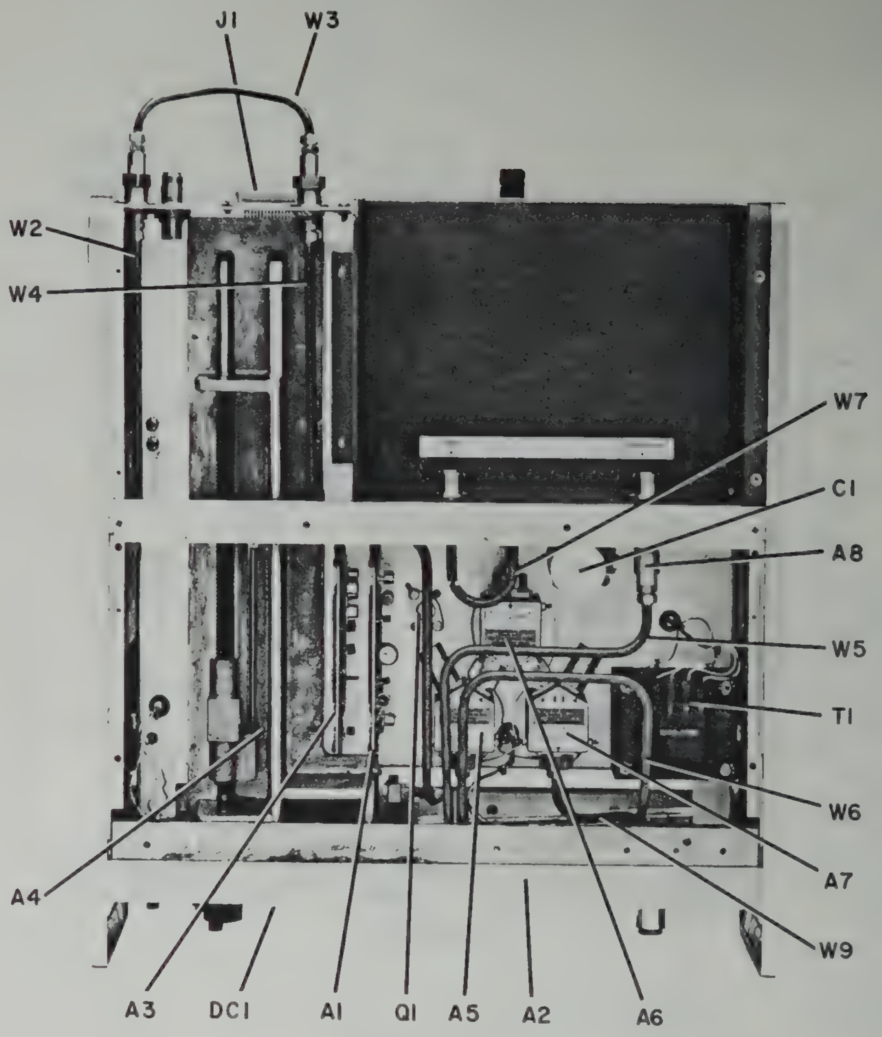


Figure 6-3. 8743A Component Identification, Top View

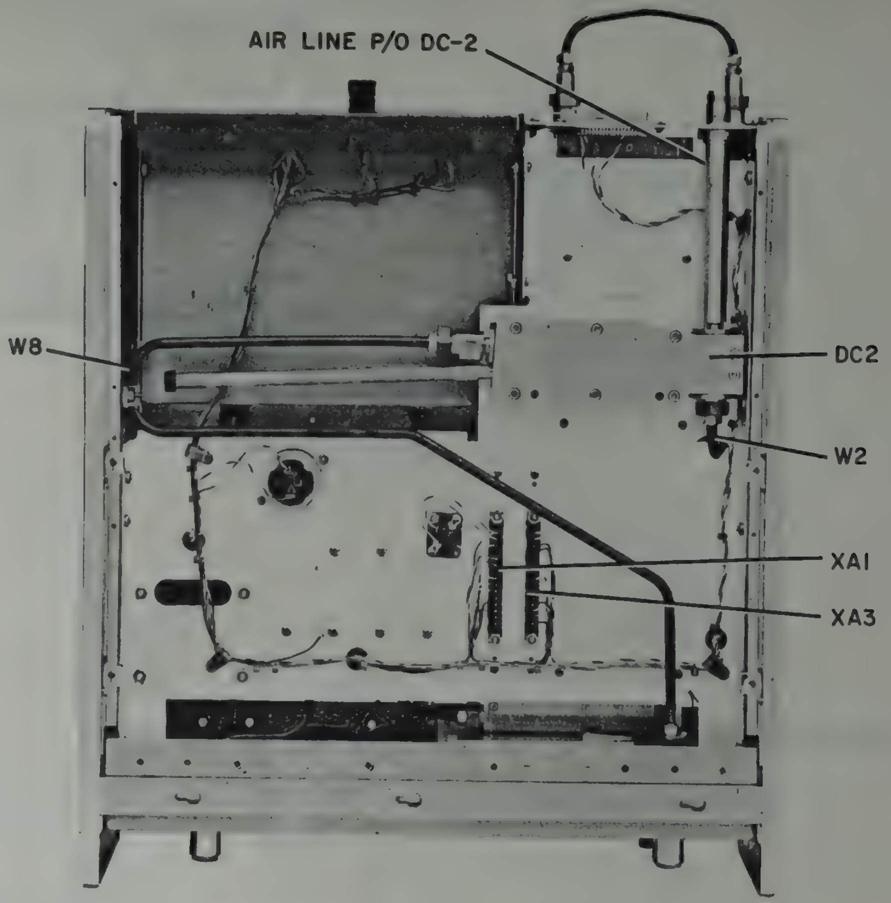


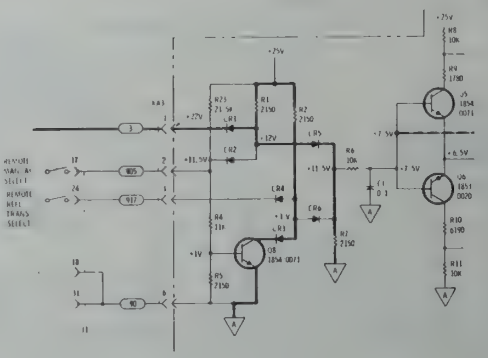
Figure 6-4. 8743A Component Identification, Bottom View

MANUAL CONTROL

REFLECTION

REFLECTION

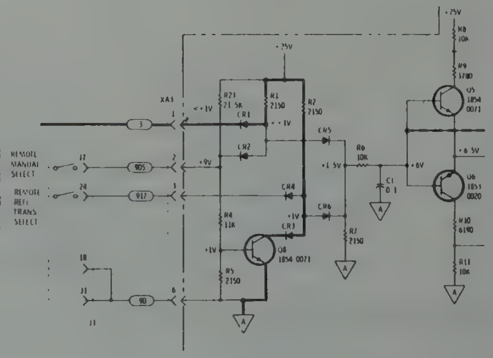
A high output from the flip-flop reverse biases CR1. With CR1 open the majority of current through R1 flows through CR5 and R7. The voltage across R7 is > 6V which turns Q5 on and Q6 off.



TRANSMISSION

TRANSMISSION

A low output from the flip-flop causes CR1 to conduct which reverse biases CR5. The voltage across R7 decreases to < 3V which turns Q5 off and Q6 on.



REMOTE CONTROL

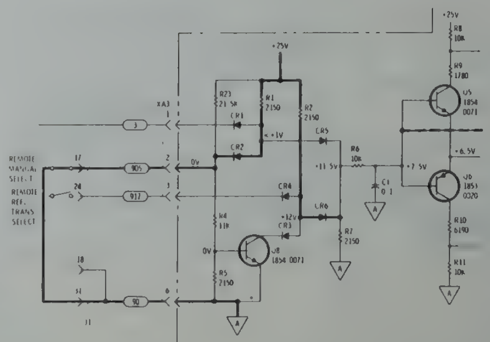
REFLECTION

REMOTE OPERATION SELECT

Shorting pin 17 to pin 18 or 36 of J1 causes CR2 to conduct and clamps R1-CR5 junction to about +1V. With R1-CR5 junction clamped the flip-flop output has no effect, and CR5 is open. Thus manual (front-panel) operation is disabled.

REFLECTION

Shorting pin 17 to pin 18 or 36 of J1 cuts Q9 off by shorting base to emitter. With Q9 cut off CR6 conducts and the voltage across R7 is high (> 6V) which turns Q5 on and Q6 off.



TRANSMISSION

REMOTE OPERATION SELECT

Shorting pin 17 to pin 18 or 36 of J1 causes CR2 to conduct and clamps R1-CR5 junction to about +1V. With R1-CR5 junction clamped the flip-flop output has no effect, and CR5 is open. Thus manual (front-panel) operation is disabled.

TRANSMISSION

Shorting pin 24 to pin 18 or 36 of J1 causes CR4 to conduct and CR6 is open. The voltage across R7 is low (< 3V) which turns Q5 off and Q6 on.

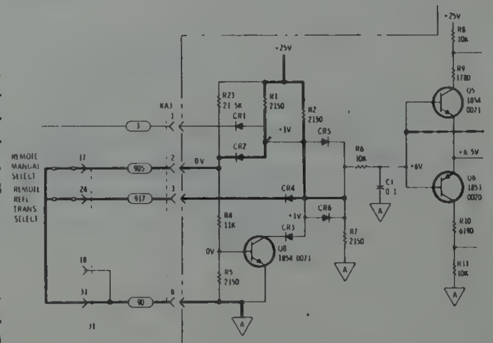
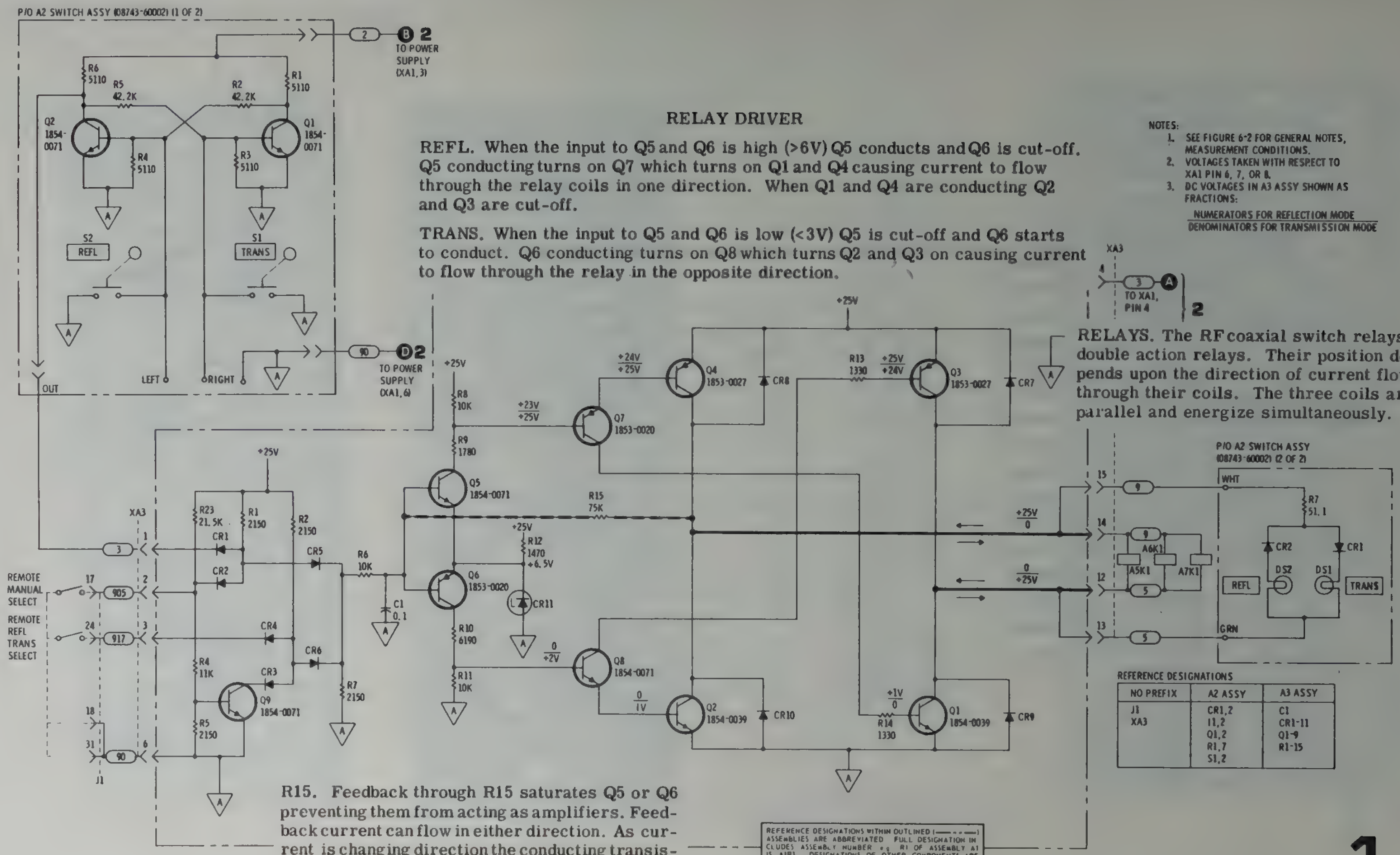


Figure 6-7. Relay Driver Input Circuit Talking Schematic Diagram

FLIP-FLOP. In manual or front panel operation the flip-flop controls the relay driver circuit. The flip-flop output is taken from the collector or Q2. Depressing the REFL pushbutton grounds the base of Q2, cutting Q2 off. The output is then high. Depressing the TRANS pushbutton cuts Q1 off. When Q1 is cut-off its collector is high which causes Q2 to conduct. The output of Q2 is then low.



RELAY DRIVER

REFL. When the input to Q5 and Q6 is high (>6V) Q5 conducts and Q6 is cut-off. Q5 conducting turns on Q7 which turns on Q1 and Q4 causing current to flow through the relay coils in one direction. When Q1 and Q4 are conducting Q2 and Q3 are cut-off.

TRANS. When the input to Q5 and Q6 is low (<3V) Q5 is cut-off and Q6 starts to conduct. Q6 conducting turns on Q8 which turns Q2 and Q3 on causing current to flow through the relay in the opposite direction.

NOTES:
1. SEE FIGURE 6-2 FOR GENERAL NOTES, MEASUREMENT CONDITIONS.
2. VOLTAGES TAKEN WITH RESPECT TO XA1 PIN 6, 7, OR 8.
3. DC VOLTAGES IN A3 ASSY SHOWN AS FRACTIONS:

$$\frac{\text{NUMERATORS FOR REFLECTION MODE}}{\text{DENOMINATORS FOR TRANSMISSION MODE}}$$

RELAYS. The RF coaxial switch relays are double action relays. Their position depends upon the direction of current flow through their coils. The three coils are in parallel and energize simultaneously.

REFERENCE DESIGNATIONS

NO PREFIX	A2 ASSY	A3 ASSY
J1 XA3	CR1,2 I1,2 Q1,2 R1,7 S1,2	C1 CR1-11 Q1-9 R1-15

REFERENCE DESIGNATIONS WITHIN OUTLINED (— · · —) ASSEMBLIES ARE ABBREVIATED FULL DESIGNATION INCLUDES ASSEMBLY NUMBER e.g. R1 OF ASSEMBLY A1 IS A1R1 DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN

R15. Feedback through R15 saturates Q5 or Q6 preventing them from acting as amplifiers. Feedback current can flow in either direction. As current is changing direction the conducting transistor Q5 or Q6 is held on until voltage across R7 passes through the range of ≈3V to ≈6V, preventing the relay driver from switching on noise. If the relay driver is in TRANS mode it will not switch to REFL mode until voltage across R7 is above +6V. If the relay driver is in REFL mode, it will not switch to TRANS mode until voltage across R7 is below 3V.

Figure 6-8. Relay Driver Talking Schematic Diagram

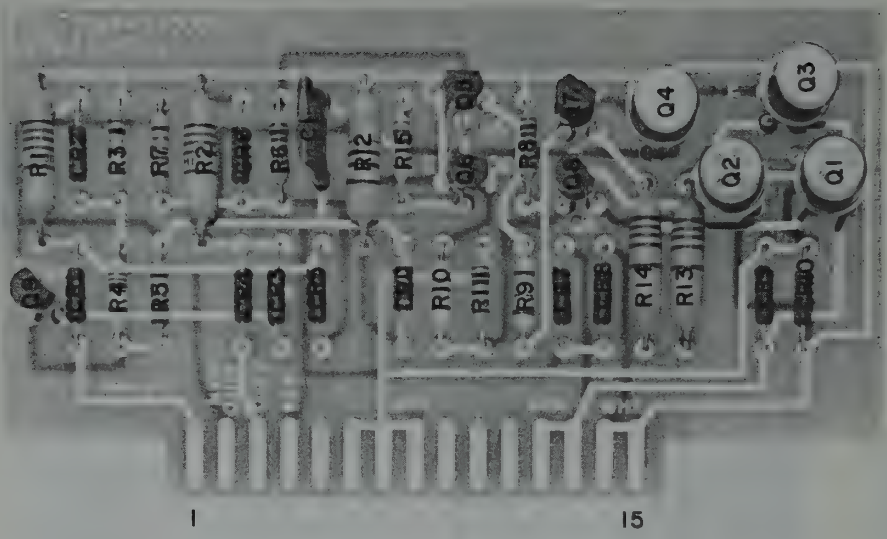


Figure 6-9. Relay Driver Assy Component Identification

(Applies to A3 Assembly, HP Part No. 08743-60038 except for Q1 through Q4, which are identified on the PC Board.)

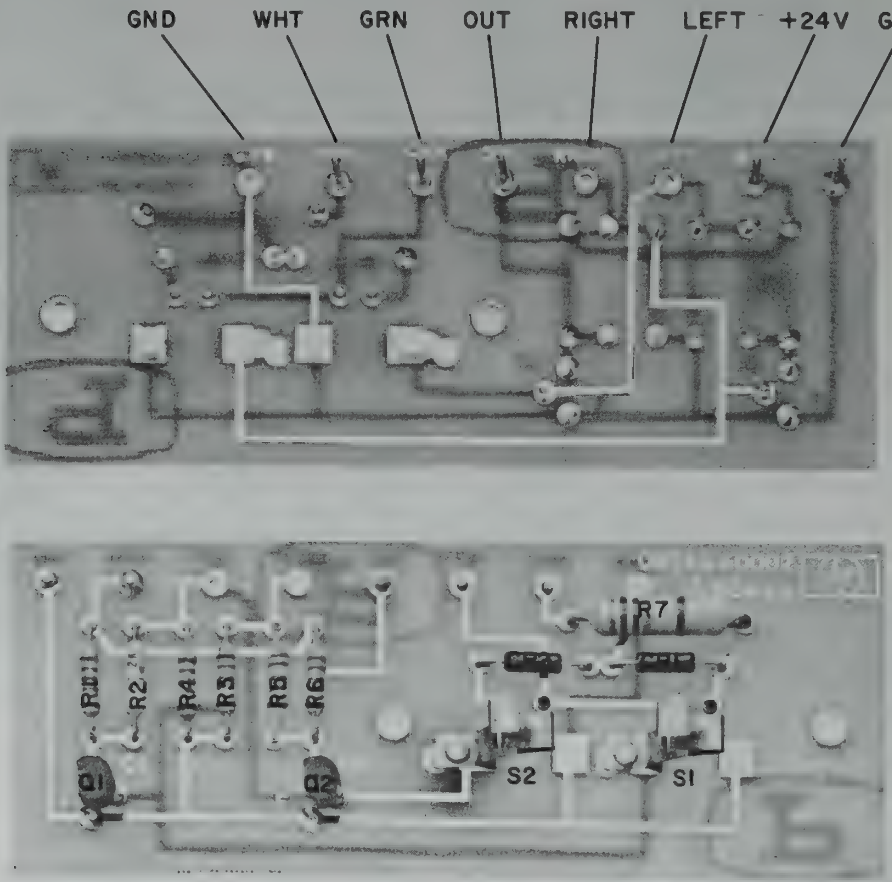
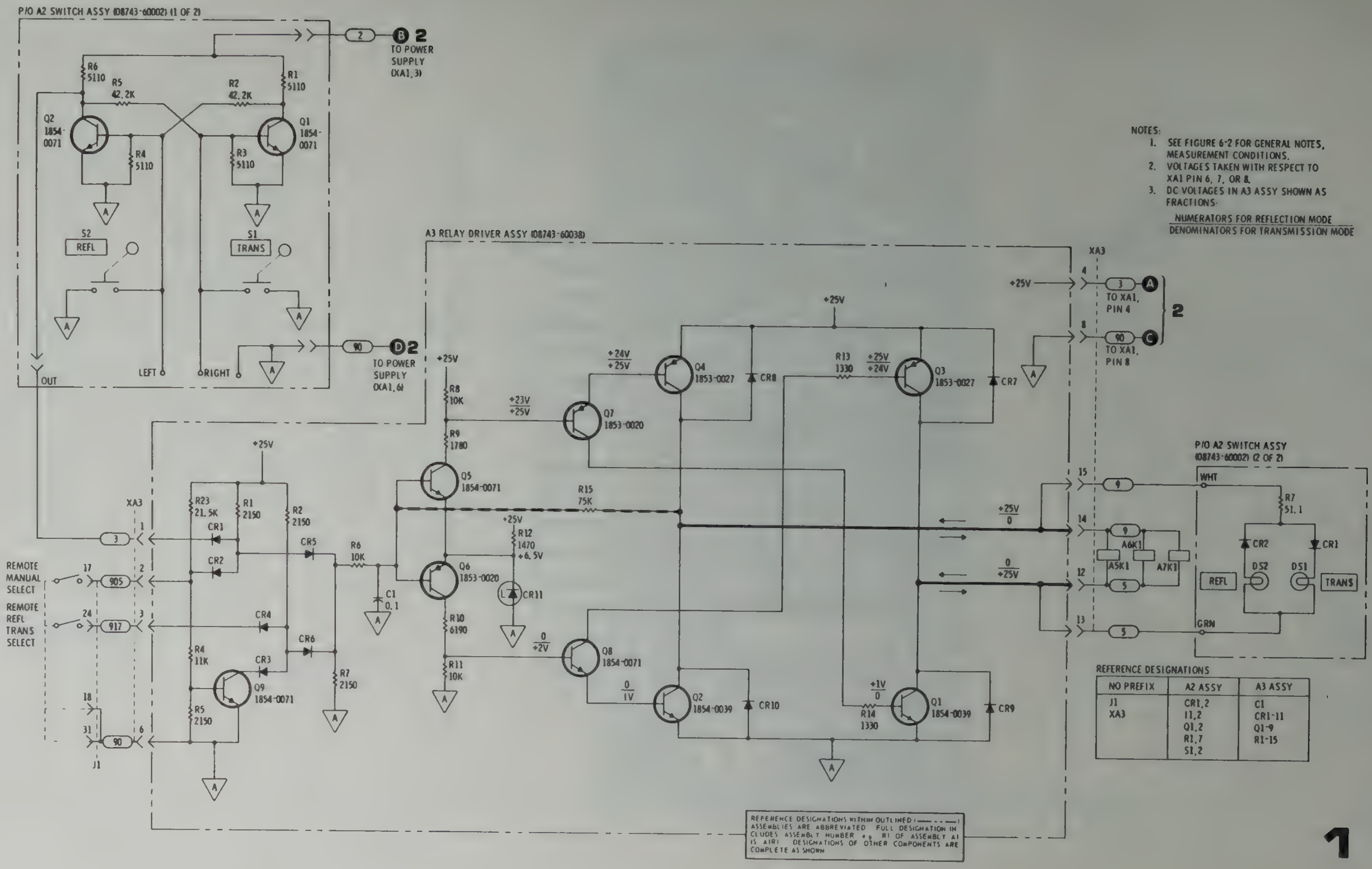


Figure 6-10. Switch Assy Component Identification



NOTES:
1. SEE FIGURE 6-2 FOR GENERAL NOTES, MEASUREMENT CONDITIONS.
2. VOLTAGES TAKEN WITH RESPECT TO XA1 PIN 6, 7, OR 8.
3. DC VOLTAGES IN A3 ASSY SHOWN AS FRACTIONS:
$\frac{\text{NUMERATORS FOR REFLECTION MODE}}{\text{DENOMINATORS FOR TRANSMISSION MODE}}$

REFERENCE DESIGNATIONS

NO PREFIX	A2 ASSY	A3 ASSY
J1 XA3	CR1,2 I1,2 Q1,2 R1,7 S1,2	C1 CR1-11 Q1-9 R1-15

REFERENCE DESIGNATIONS WITHIN OUTLINED (—— - - ——) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER e.g. R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.

Figure 6-11. Relay Driver Assy Schematic Diagram

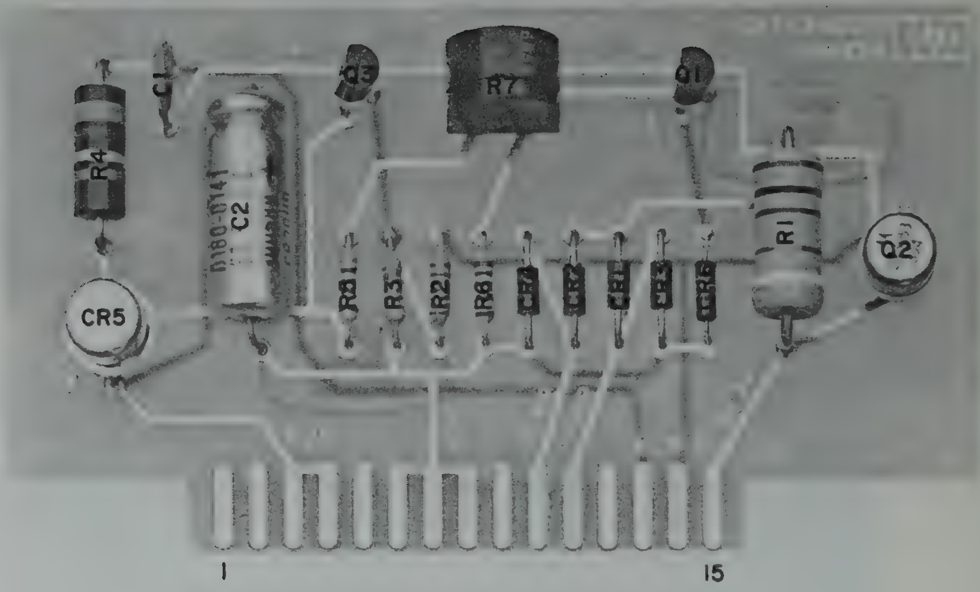
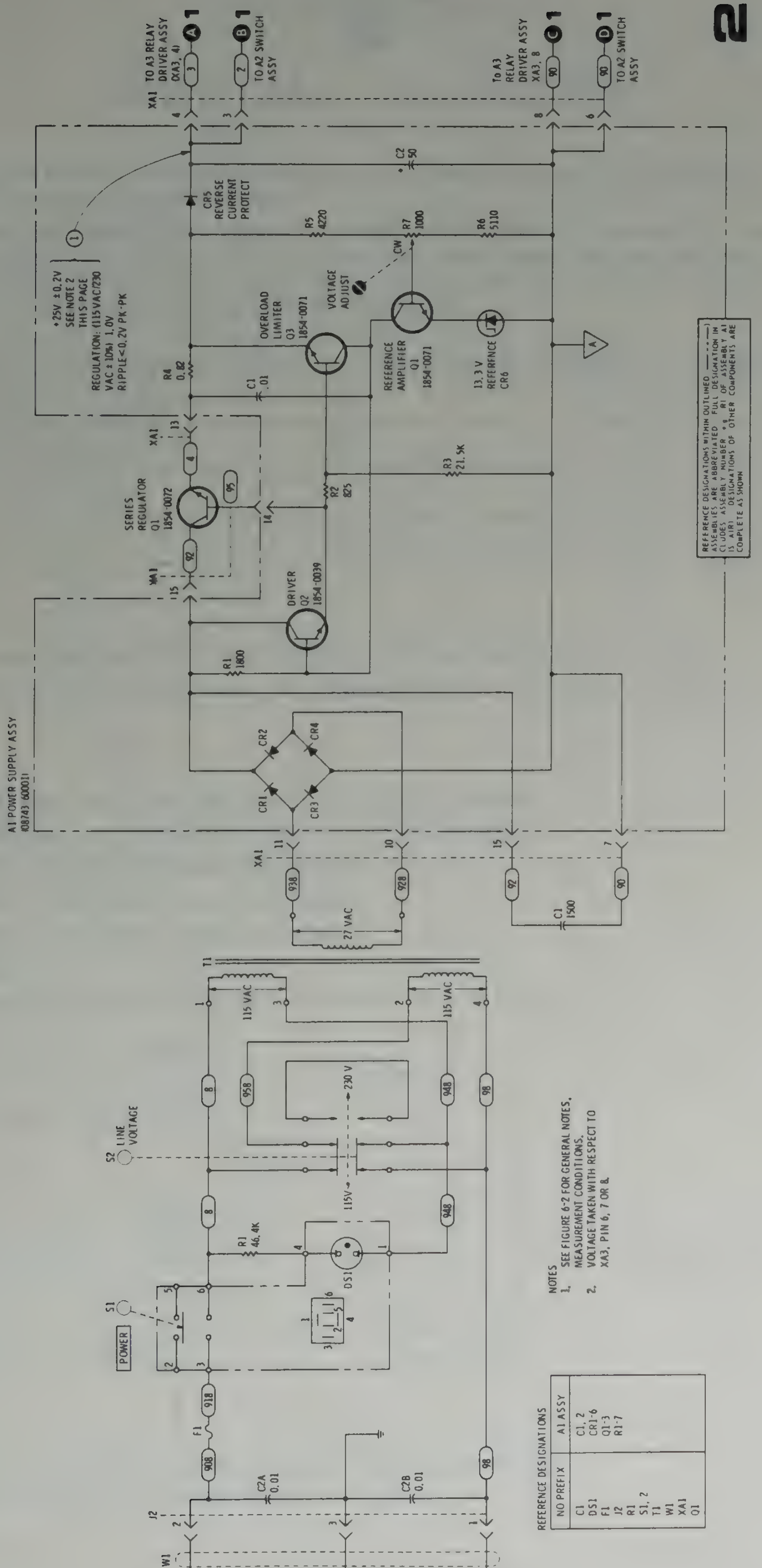


Figure 6-12. Power Supply Assy Component Identification



REFERENCE DESIGNATIONS WITHIN OUTLINED ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN

NOTES
1. SEE FIGURE 6-2 FOR GENERAL NOTES, MEASUREMENT CONDITIONS.
2. VOLTAGE TAKEN WITH RESPECT TO XA3, PIN 6, 7 OR 8.

REFERENCE DESIGNATIONS

NO PREFIX	A1 ASSY
C1	C1, 2
DS1	CR1-6
F1	Q1-3
J2	R1-7
R1	
S1, 2	
T1	
W1	
XA1	
Q1	

Figure 6-13. Power Supply Schematic

APPENDIX

HEWLETT hp PACKARD

MANUAL CHANGES

To adapt this manual to instruments with Serial Numbers listed in the table below, make the indicated manual changes.

Information for adapting this manual to instruments with Serial Numbers not listed below may be included in a yellow MANUAL CHANGES insert supplied with this manual. Information about Serial Numbers not covered in any of these ways can be obtained from the nearest Hewlett-Packard office.

► NEW ITEM.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES	SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
834-	A, B, C, D		
917, 928	B, C, D		
968-, 990-	C, D		
1141	D		

CHANGE A

Page 5-3, Table 5-1:

Change A3R12 to HP Part No. 0757-0816 R: FXD MET FLM 681 OHM 1% 1/2W.

Change A3R15 to HP Part No. 0757-0458 R: FXD MET FLM 51.1K OHM 1% 1/8W.

CHANGE B

Page 5-3, Table 5-1:

Change F1 (115V) to HP Part No. 2110-0008 FUSE: 1/2A SLOW-BLOW.

Change F1 (230V) to HP Part No. 2110-0340 FUSE: 0.25A SLOW-BLOW.

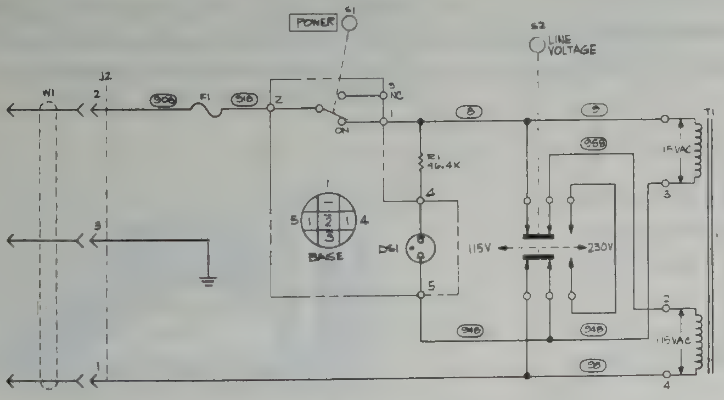
Change S1 to HP Part No. 3101-0100 (Same description).

Change S2 to HP Part No. 3101-1235 (Same description).

Change W1 to HP Part No. 8120-0078 (Same description).

Page 6-11, Figure 6-13:

Replace power supply primary circuit with partial schematic shown below.



NOTES:
1. SEE FIGURE 6-2 FOR GENERAL NOTES, MEASUREMENT CONDITIONS
2 VOLTAGE TAKEN WITH RESPECT TO XA3, PIN 6, 7 OR 8

CHANGE C

Page 5-2, Table 5-1:

Change A1R4 to HP Part No. 0811-1672 R: FXD WW 0.82 OHM 5% 2W.

Change A3 to HP Part No. 08743-60003 (Same description).

CHANGE D

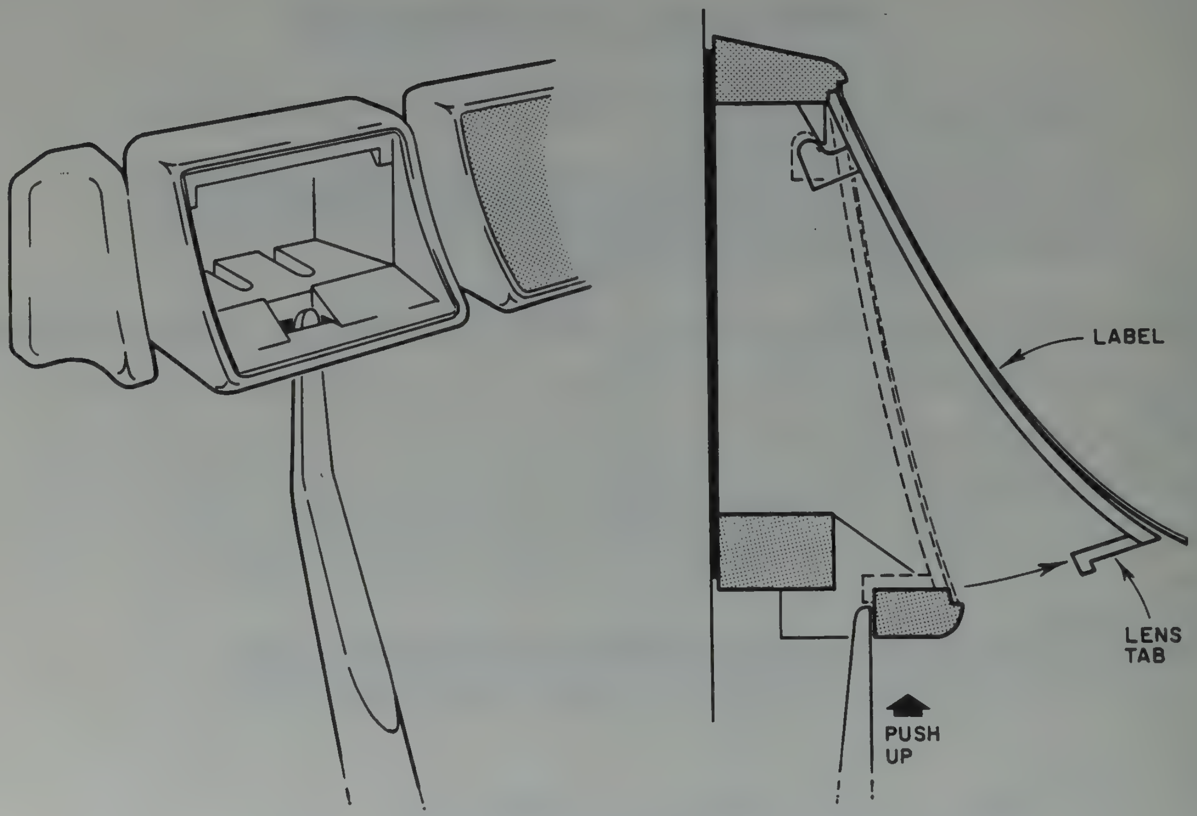
Page 3-15, Figure 3-12:

Use the following Figure 3-12 in place of the Figure 3-12 shown in the manual.

Page 5-4, Table 5-1:

Delete 08743-00024 listing.

PUSHBUTTON LAMP REPLACEMENT



1. DO NOT REMOVE PUSHBUTTON. Remove pushbutton lens and label by inserting a soldering aid or other small, blunt tool in the slot in the bottom of the pushbutton. Press tool forward against lens tab to release lens and label. If pushbutton comes out see NOTE in Step 3.

2. Remove defective lamp. A needle-nose pliers or tweezers can be used as an extracting tool. Install new lamp (HP part number 2140-0213).

3. Press lens and label into place in pushbutton opening.

NOTE:
If the pushbutton has been removed:

a. Reinstall pushbutton, lens and label removed.
b. Insert the metal contactor in slot of pushbutton as shown. If contactor is not inserted in slot properly, switch may stay on at all times.

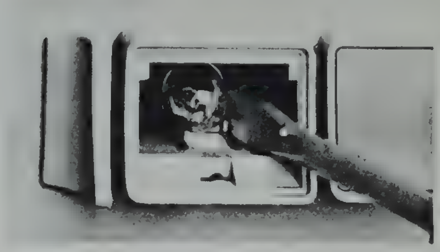


Figure A-1. Pushbutton Lamp Replacement

MANUAL CHANGES

MANUAL IDENTIFICATION
Model Number: 8743A
Date Printed: July 1972
Part Number: 08743-90010

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
1330A	Errata		
▶ 1702A	1		

▶ NEW ITEM

ERRATA

Title Page:
Change SERIALS PREFIXED to read,

SERIALS PREFIXED: 1226 and 1330A

This manual applies directly to HP Model 8743A Reflection-Transmission Test Units having serial prefix number 1226- and 1330A-.

Page 1-1, Paragraph 1-5:
Delete all references to Rack Mounting Kit.

Page 1-2, Paragraph 1-11:
Add: "A Rack Mounting Kit is available to install the instrument in a 19-inch rack. Rack Mounting Kits may be obtained through your nearest Hewlett-Packard Office by ordering HP Part Number 5060-8740."

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

28 JANUARY 1977
3 Pages

HEWLETT hp PACKARD

Printed in U.S.A.

ERRATA (Cont'd)

Page 4-7, Reflection Check:
Add the following:

NOTE

A5, A6, and A7 are a matched set of switches and should be replaced only when necessary; individual replacement of A5, A6, or A7 assemblies may degrade performance of the instrument. A switch tree (HP Part No. 5080-0310), consisting of matched A5, A6, and A7 assemblies, is the recommended replacement.

Change A6 Test Port Relay Assembly to HP Part No. 5080-0301.
Change A5 Unknown Port Relay Assembly to HP Part No. 5080-0303.
Change A7 Transmission Return Port Relay Assembly to HP Part No. 5080-0302.

Page 4-8, Figure 4-2 (Sheet 3 of 4):
Change Directional Coupler DC1 to HP Part No. 5080-0288.

Page 5-3, Table 5-1:
Change the parts list to reflect the changes shown below:

Reference Designation	HP Part Number	Description
A5, A6, A7	5080-0310	SWITCH TREE: MATCHED SET OF THREE (RECOMMENDED REPLACEMENT)
A5, A6, A7	5080-0289	SWITCH TREE: MATCHED SET OF THREE OPTION 018 ONLY (RECOMMENDED REPLACEMENT)
A5	5080-0303	RELAY ASSY, UNKNOWN PORT (IF REPLACED SEPARATELY, MAY DEGRADE PERFORMANCE OF INSTRUMENT)
A6	5080-0301	RELAY ASSY, TEST PORT (IF REPLACED SEPARATELY, MAY DEGRADE PERFORMANCE OF INSTRUMENT)
A7	5080-0302	RELAY ASSY, TRANSMISSION RETURN PORT (IF REPLACED SEPARATELY, MAY DEGRADE PERFORMANCE OF INSTRUMENT)
DC1	5080-0316	DIRECTIONAL COUPLER (TEST)
DC1	5080-0288	DIRECTIONAL COUPLER (TEST) OPTION 018
DC2	5080-0300	DIRECTIONAL COUPLER (INPUT)

Page 5-4, Table 5-1:
Change XF1 to HP Part No. 2110-0470 FUSEHOLDER -EXTR POST (RECOMMENDED REPLACEMENT).

Page 6-5, Figure 6-6:
Change assembly descriptions to read as follows:
A5 UNKNOWN PORT RELAY ASSY (5080-0303)
A6 TEST PORT RELAY ASSY (5080-0301)
A7 TRANSMISSION RETURN PORT RELAY ASSY (5080-0302)
DC1 DIRECTIONAL COUPLER (5080-0316)
DC2 DIRECTIONAL COUPLER (5080-0300)

►CHANGE 1

Page 5-3, Table 5-1:
Change S1 to HP Part No. 3101-2195 SWITCH: PUSHBUTTON DPST.

Page 6-11, Figure 6-13:
Change the primary power circuit as shown on the attached schematic (Figure 6-13A).

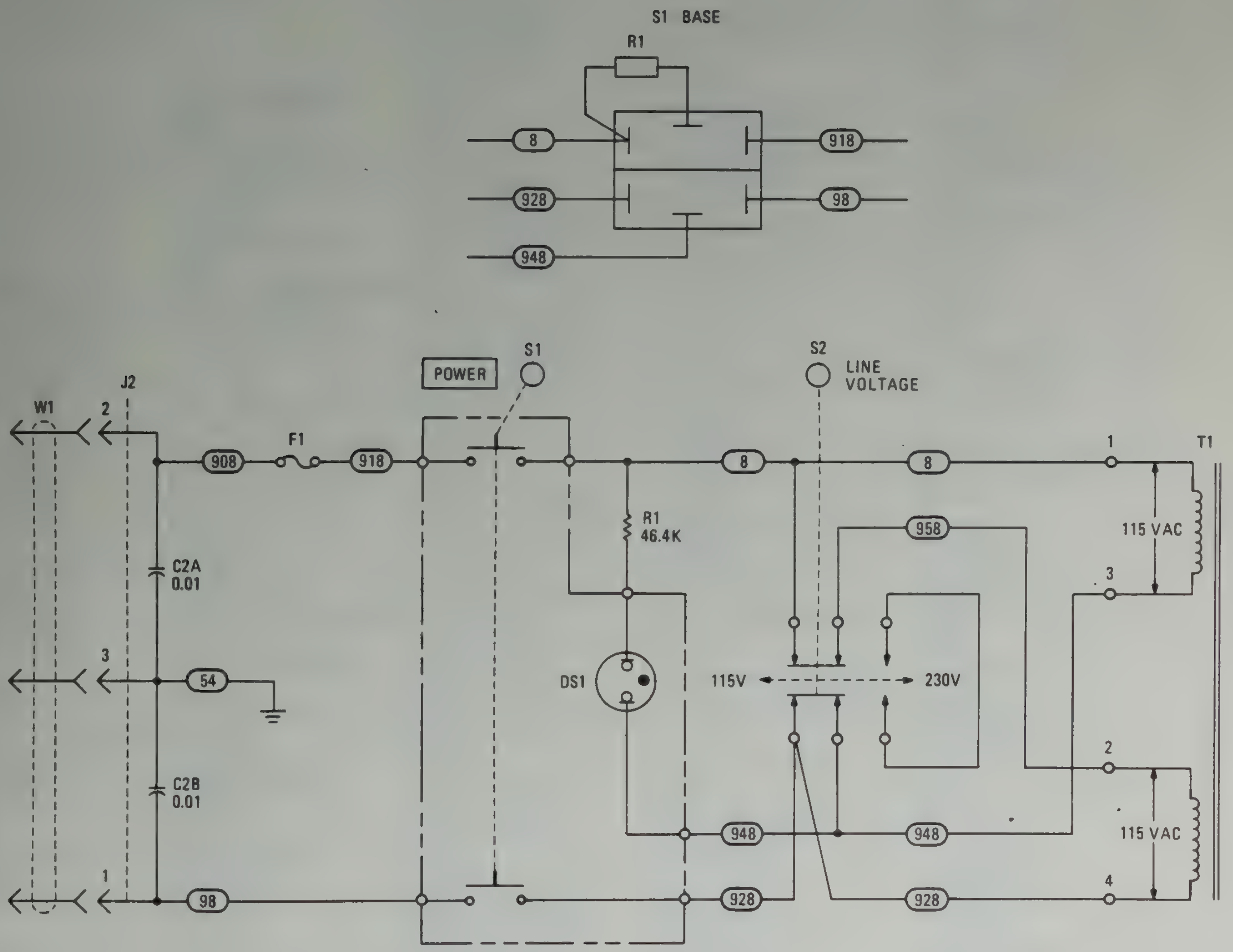


Figure 6-13A. Power Supply Partial Schematic (CHANGE 1)

SALES & SUPPORT OFFICES

Arranged Alphabetically by Country

Product Line Sales/Support Key

Key	Product Line
A	Analytical
CM	Components
C	Computer Systems Sales only
CH	Computer Systems Hardware Sales and Services
CS	Computer Systems Software Sales and Services
E	Electronic Instruments & Measurement Systems
M	Medical Products
MP	Medical Products Primary SRO
MS	Medical Products Secondary SRO
P	Personal Computation Products
*	Sales only for specific product line
**	Support only for specific product line

IMPORTANT: These symbols designate general product line capability. They do not insure sales or support availability for all products within a line, at all locations. Contact your local sales office for information regarding locations where HP support is available for specific products.

HP distributors are printed in italics.

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